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September-October 1953

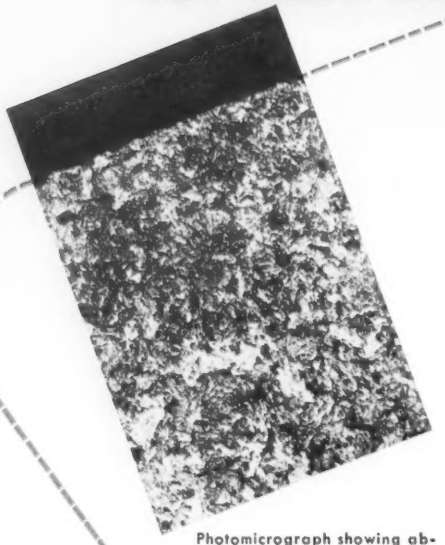
METAL TREATING

MTI MASTER CRAFTSMEN
METAL TREATING INSTITUTE

THIRD ANNIVERSARY ISSUE

THE *Only* MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

SCALE FREE—DECARB FREE **Hardening for ALL Engineering Steels**



Photomicrograph showing absence of scale or decarburization in a section of S.A.E. 1085 steel (X100) neutral salt bath hardened at 1500°F. and quenched in oil. (Etched in 2% Nital.)

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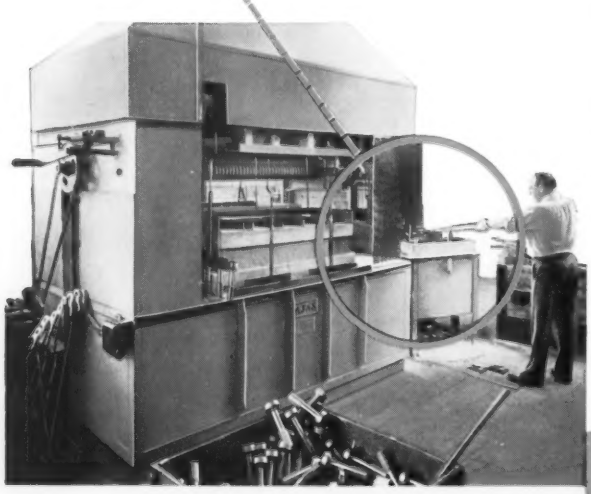

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Editorial...

OUR COVER AND OUR THIRD ANNIVERSARY

By now, no doubt, you have noticed on our front cover the two predominant aspects of this issue—a departure from our usual cover design and the fact that we are celebrating our Third Anniversary.

METAL TREATING has come a long way in the past three years. Since our initial issue you have seen the growth of METAL TREATING to the point where it covers the entire heat treating industry. From the many letters we have received from our readers there is little doubt that we are accomplishing our aim of providing helpful information to the heat treating industry. Our plans for the future are centered around assisting in its advancement through the publication of information on its problems, new equipment, new techniques and new materials.

Our front cover is symbolic of the contribution which heat treating has made to both art and industry in recent years. Shown in the illustration is Mrs. Buell Mullen, a highly accomplished artist, who has developed a technique for painting on stainless steel. Starting with bright stainless steel sheets a special heat treatment (performed by Metlab Company, Philadelphia, Pennsylvania) resulted in the desired background tone. In order to get permanent adherence of oil paint to the metallic surface, a special electric tool cuts and roughens the sheet, creating the design which is then painted in various colors. In some places simple burnishing or cutting is used to bring out the natural color of the metal for further contrast. Novel and strikingly beautiful effects are achieved by skillful use of the original and oxidized metal surfaces in combination with staining, painting and engraving techniques.

We wish to express our sincere thanks to Mrs. Buell Mullen and to the Electro Metallurgical Co., a division of the Union Carbide and Carbon Corp. of New York, for their cooperation and permission to reproduce the photograph.

METAL TREATING

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National Trade Association of Commercial Heat Treaters

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HORACE C. KNERR, *Chmn., Pub. Comm.*, Metlab Co., Phila., Pa.
C. E. HERINGTON, *Editor*
B. A. FLANAGAN, *Advtg. & Prod. Mgr.*, JOHN J. CODELLA, *Business Mgr.*
271 North Ave., New Rochelle, N. Y.

SALES REPRESENTATIVES
R. F. PICKRELL, 314 Stephenson Bldg., Detroit 2, Mich.—TR 1-0790
W. F. GREEN, 439 S. Western Ave., Los Angeles 5, Calif.—DU 7-8135
DICK WESTON, 6 East 39th St., New York, N. Y.—MU 5-9450

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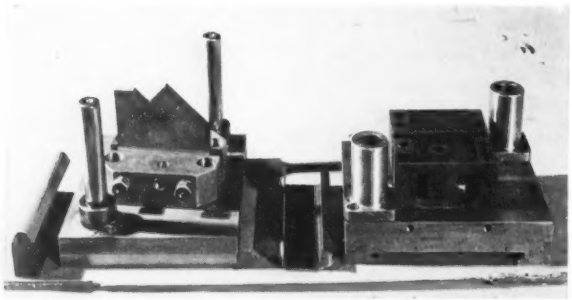
Short Cycle Hardening of Tool Steels

By J. Y. RIEDEL
Tool Steel Engineer
Bethlehem Steel Company
Bethlehem, Pennsylvania

The conventional heat treatment operations used to harden high speed steel tools are well known to all heat treaters. High speed steel hardening heat treatment operations involve heating the tools to an unusually high quenching temperature (above 2000°F) for a short time and after quenching, a relatively high temperature (above 1000°F) tempering operation is used. The same type of treatment cycle, when used on types of tool steel other than high speed steel, has not usually been considered to be of practical use. Most tool steels, when heated above 2000°F for quenching, retain so much austenite that a satisfactory working hardness cannot be developed.

Recently, an investigation was made of short-time, high-temperature treatments of high-carbon high-chromium tool steel (SAE type D2).* The primary



High-Carbon, high-chromium cut-off die for 35-ton flying shear. Cuts cold-formed, 0.093-inch strip steel for overhead garage door track. Rockwell C-61. Cut 7000 pieces between grinds after short-time, high-temperature treatment.

object of this work was to develop a procedure for hardening this type of steel in less time than is required by conventional procedures. The reader is referred to Metal Progress, February 1953, pages 67-70, where complete detail is given about the work on this subject. Essentially, the problem which had to be solved was to transform the austenite resulting from high temperature quenching while maintaining the working hardness desired (Rockwell C-60 or higher). Some of the data obtained in this investigation are reproduced below. One-inch round specimens were preheated at 1500°F for 45 minutes, transferred to a high heat furnace at the temperature indicated and held 5¼ minutes, then air cooled (quenched)

High Heat (Quenching) Temperature	Rockwell Hardness	
	As Quenched	*After Chilling*
1850°F	C-60	C-60
1900	60	62
1950	61	64
2000	61	65
2050	60	66
2100	58	65
2150	46	63
2200	43	57
2250	39	44
2300	37	40
2350	37	38

Table I—Hardness of D2 Tool Steel vs. Quenching Temperature

to room temperature. After checking hardness, the specimens were chilled in liquid nitrogen at −319°F (1 hr.) and hardness (at room temperature) was again checked.

The results of these tests indicate the following, with regard to the short (5¼ minutes) holding time at the quenching temperature:

a. At temperatures from 1850 to 1950°F, full hardness cannot be obtained because of insufficient carbide solution.

b. At temperatures from 2000 to 2100°F, sufficient carbide solution has occurred for full hardening to result. Quenching from this temperature range produces low as-quenched hardness because of retained austenite. The development of full hardness by subzero chilling shows that the retained austenite can be transformed readily.

c. At temperatures from 2150 to 2350°F, sufficient carbide solution has occurred so as to produce large amounts of retained austenite which are so stable that they do not fully transform during sub-zero chilling.

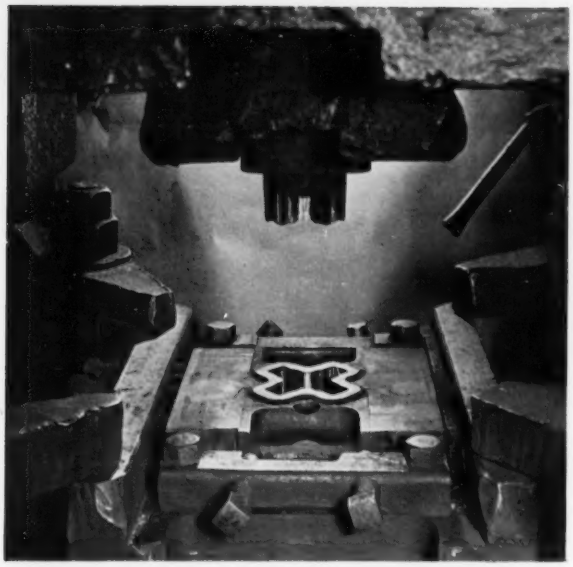
Theoretically, the foregoing data provides a short cycle for hardening high-carbon high-chromium (type D2) tool steel, as follows:

1. Preheat to 1500°F. (45 min. at heat).
2. High heat to 2100°F. (5¼ min. in furnace).
3. Air cool to room temperature.
4. Subzero chill in liquid nitrogen (1 hr.).
5. Temper to desired hardness (usually Rockwell C-60).

On a practical basis, this cycle may not be of value because liquid nitrogen is not available in most heat treatment shops and because subzero chilling of tools which have not been tempered may cause cracking of the tools.

*Editor's Note: This table lists the conventional treatments for steels covered by this article.

SAE No.	Type	Preheat	Hardening Temperature	Quench Medium	Tempering Temperature
D2	High C-High Cr	1200-1300°F	1800-1875°F	Air	400-700°F
D3	High C-High Cr	1200-1300°F	1750-1800°F	Oil	400-700°F
A2	5% Cr, Air Hard	1200-1300°F	1725-1775°F	Air	400-700°F



Four-piece composite trimming die made of high-carbon, high-chromium tool steel, used in service tools. Hardened by short-time, high-temperature treatment.

It was found that tempering treatments above 900°F could be used to obtain transformation of the austenite produced by high temperature quenching. The following tempering series was run on specimens quenched from 2100°F in the manner described above.

Tempering Temperature	2100°F Quench	
	1st Temper	2nd Temper
None	C-58	—
850°F	55	C-55
900	56	57
950	60	61
1000	61	61
1050	58	55
1100	53	50
1150	48	46

Table II—Rockwell Hardness of D2 Tool Steel vs. Tempering Temperature

Similar results can be obtained on specimens quenched anywhere in the range of 2000°F to 2250°F; the development of Rockwell C-60 after tempering depends only upon the selection of the proper tempering temperature.

Recommended Treatment

A conservative short cycle for hardenig 1-in. diameter specimens of high-carbon high-chromium tool steel without the necessity of subzero chilling can be outlined as follows. (Sections larger than 1 in. can be treated in a similar manner by increasing the heating time in proportion to the size of the tools).

1. Preheat to 1500°F (45 minutes at heat).
2. High heat to 2100°F (5¼ minutes in the furnace).
3. Air cool to room temperature.
4. Temper at 1000°F (2 hours) air cool.
5. Retemper 400°F minimum (400-950°F).

Because of the extremely short time the steel is at the quenching temperature, one can heat treat tools of high-carbon high-chromium steel by this method in ordinary fuel-fired furnaces without encountering excessive decarburization or soft skin. Normal grinding operations to remove scale and produce a smooth surface will serve to remove the slight amount of decarburization, just as in conventional heat treatment of high speed steel.

In ordinary practice tools should not be cooled in the quench all the way down to room temperature, but should be removed from the quench while warm and tempered immediately. However, because of the relatively large amounts of stable austenite produced by the cycle above specified, it is safe to cool tools treated by this method all the way down to room temperature. Tempering can be done when convenient but should not be delayed unnecessarily.

Service Tests

To determine the effect of this short-time high speed steel type of heat treatment on tool life, we made service trials on trimmer dies for cold trimming alloy steel forgings. These dies are subjected to some shock loading as well as wear on the cutting edges. Forgings were selected which could be readily measured with a micrometer, as a means of evaluating die wear. The test tools were composite dies made up from assembled sections which enabled us to compare sections treated in different ways.

The data obtained on these tests cannot be reproduced here. However, the results showed that wear on the dies treated by the short-time high-temperature cycle was approximately only 50% of the wear on dies treated in the conventional manner from 1850°F. These service tests were made primarily to determine whether tools treated by the short-time high-temperature cycle would safely withstand normal service stresses. It was an unexpected result that the wear resistance would be improved by the newly developed method of treatment.

Tests on Type D3 High-Carbon High-Chromium Tool Steel

The results of the work described above lead to an obvious question. Can this type of treatment be used on other types of tool steels? One of the most logical choices of tool steel grade on which to try the short-time high-temperature type of treatment is the oil-hardening type of high-carbon high-chromium tool steel (SAE type D3). With this steel, however, the problem is slightly different because the normal working hardness of tools of this grade is Rockwell C-63.

One inch round specimens were preheated at 1500°F for 45 minutes, transferred to a high heat furnace at 2050°F, held 5¼ minutes, oil quenched to room temperature, and then tempered for one hour at various temperatures. The hardness produced by

(Continued on page 26)

FLAME HARDENING AND ITS APPLICATION TO MEEHANITE METAL

WITH AN IMPROVED TORCH DESIGN

By Ron Ekins
Commercial Sales
Otis Elevator Company Limited
Hamilton, Ontario, Canada

Until recently, flame hardening equipment was patterned off the same type of orifice as the standard welding torch. This orifice as shown in Fig. 1-A is straight sided throughout its length, being of various lengths to give different flame characteristics. In ordinary oxyacetylene operations this construction has proved very satisfactory, however, it presented difficulty due to flame instability because of the close proximity of other flames and the water quench on the flame hardening head.

With the development of the new type orifice as shown in Fig. 1-B considerable improvement in flame hardening operations has been realized. Notice how the swaged ring has closed in the neck of the orifice. The underlying principle of this shape being that the gas velocity is increased at the neck of the orifice above that of the flame velocity prohibiting the propagation of the flame back into the torch and mixture.

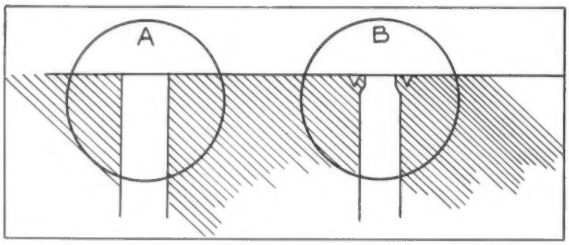


Fig. 1—Old and new type orifices for flame hardening tips.

In Fig. 2 are shown an old and a new type tip. On the right is the straight sided orifice tip with holes staggered to avoid the condition of flame interference and on the left is the swaged neck orifice placed in a straight line which gives a greater flame concentration in a given area. The flame concentration results in a narrower heat band and overcomes some of the difficulties accompanying a wider heat band on hard to handle materials. On the left hand tip it will also be noticed that a formed step provides a definite shield against quench interference with the flame.

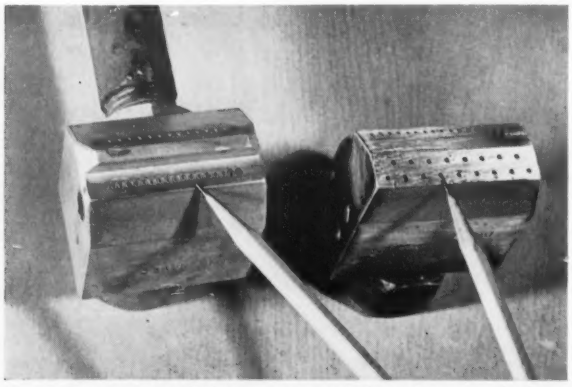


Fig. 2—New type tip at left increases gas velocity and prevents the flame from blowing back into the torch.

Fig. 3—A variety of tip shapes which will meet the more common flame hardening requirements.

With the advent of the improved tip it has now become possible to use standard welding torches of the heavy duty design, with an extension from the torch connecting the flame hardening tip. The extension and the tip only are water cooled.

Standardization of flame hardening tip shapes is almost beyond attainment. However, the variety shown in Fig. 3 has taken the principal steps to accomplish this. Combinations of these shapes or the individual tips alone will meet a vast majority of flame hardening shape requirements. Although it has been claimed that flame hardening can be done manually, only the most experienced operator with a steady hand and with an unusual sense of timing of the traverse of the torch can hope to accomplish an even passable job.

Mechanical traverse is a necessity to assure consistent results. Constant speeds from 3" to 5" per minute will be required to meet the larger percentage of job demands. Many varieties of mechanisms have been developed in as many different plants. Rebuilt machine tools, special direct motor drives and air drives are just to mention a few. The prime requirement is that the speed of the traverse be adjustable to provide the proper speed of traverse suitable for the flame hardening job under consideration. Fig. 4 shows a flame hardening machine used for a round die while Fig. 5 gives a close-up of the torch and tip in operation along with an auxiliary quench.

The volume of gas supplied to the flame hardening tip is of utmost importance to obtain satisfactory results. A measure of the amount of oxygen and acetylene required for a flame hardening tip can be readily calculated from available cubic foot consumption charts. In using oxygen and acetylene from cylinders it is not practical to draw more than $\frac{1}{5}$th

of its capacity per hour. This from standard cylinders means approximately 50 cubic feet per hour.

Having the necessary facilities in tip, torch, traverse mechanism and gas supply let us now look at the process of flame hardening. First, however, consideration must be given to the difference between the heat conductivity, specific heat and critical temperature of Meehanite metal, and the same characteristics of different types of steel.

Simply stated we desire to impinge sufficient heat in the form of an oxyacetylene flame onto the surface of the metal to raise the temperature slightly above its critical and apply a quench to the heated surface at a predetermined time to obtain the desired hardness and depth of penetration.

To the uninitiated the water from the quench section of the torch is thought to be the principal source of cooling in flame hardening. However, practical experience has shown that the parent metal provides at least 80% of the cooling effort in the process. Because of the contribution in cooling by the parent metal in many jobs it is necessary to provide auxiliary quench equipment to prevent heat build up. Water temperatures from 40 degrees to 100 degrees have been used without any noticeable difference in hardness obtained.

A higher setting of the flame hardening head for high strength irons such as Meehanite metal is the principal difference in the process of flame hardening steel and Meehanite metal which compensates for the difference in heat conductivity, specific heat and critical temperature of these metals. Also because of these inherent properties, the heat applied and the time cycle require slightly closer adjustments to prevent the possibility on the one hand of under heated material that is soft and sometimes checked, or over heated material evidenced by a grooved surface.

Fig. 4—Equipment for flame hardening this Meehanite die casting provides for mechanical traverse.

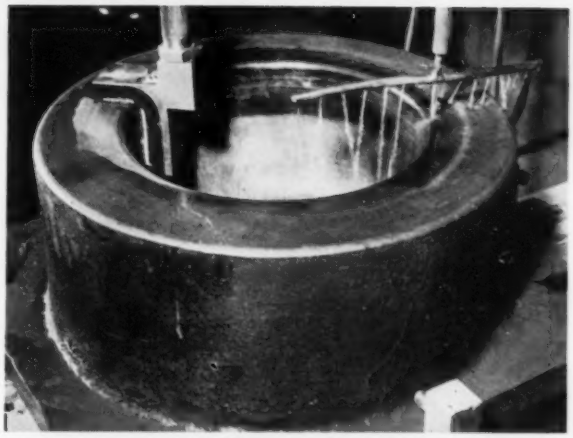


Fig. 5—A close-up of the die shown in Fig. 4. An auxiliary quench is used to cool the casting since base metal provides up to 80% of the quenching effort in the process.

For flame hardening steel, a head adjustment of ¼" from the work surface with the shield surface almost touching the face of the work is necessary. However, for Meehanite metal and other cast irons the distance is increased ⅜" with a spacing of approximately ⅛" from the shield to the work face. Experienced operators use blocks or gauges to set these important dimensions.

Using a speed of 6" per minute it is generally possible to obtain a hardened case of from ⅛" to 3/16" thick. The hardness result is the full hardness that can be obtained from the hardness producing elements in the part being treated. It has been found that a ⅛" thickness of hardness meets general requirements, however, within the range of metal characteristics it is possible to increase or decrease the penetration depth by variations of speed on a given work piece. Visually when a red heat is attained under the torch it is seen almost as a bright white. At this point the critical temperature has been reached.

Foreign substances such as paint, grease or chalk on the surface to be hardened show up under the flame as a brilliant red or white glow which could be interpreted by an inexperienced operator as a burning of the metal surface. Such is not the case, as experience will point out these changes in color are only the burning of the foreign substance.

As the technique of flame hardening has become more precise it has been accepted as a successful process when associated with materials that can meet the demands of consistency. Meehanite metal engineering grades meet the requirements of uniformity in the production cycle.

Cams, gears, rolls, draw and forming dies, peletizer tires and railway roller bearing housings are to mention but a few of the many and varied applications where flame hardened Meehanite metal has filled the specifications. ▪ ▪ ▪

by E. W. WEAVER
Assistant Chief Engineer
Surface Combustion Corporation
Toledo, Ohio

Pusher Type Furnaces

The basic function of industrial furnace equipment is the controlled application of heat to materials under specific time and temperature conditions.

This cycle can be achieved by either holding the work stationary in a furnace heating chamber and varying the temperature, as in the batch type furnaces, or by moving the work through temperature zones and varying the speed of movement through these zones. The latter or continuous type of furnace utilizes a variety of mechanisms or methods for accomplishing work movement.

A very flexible design type incorporates oscillating-motion or pusher mechanisms in which the driving mechanism is located outside the furnace heating chamber. They are actuated by electrical, mechanical or hydraulic means. Pusher furnaces are used for all types of heat treat processing involving either long or short cycles, high or low temperatures or almost any combination of these conditions. Work of a wide range of sizes and shapes can also be accommodated.

The pusher furnace design types can be considered in two ways—(1) *type of drive* and (2) *method of work loading*. The combination selected for a particular application will depend on the process and cycle being carried out, size and shape of work being treated, volume of production and other specific plant and production conditions and requirements. Applications from plant to plant will seldom duplicate each other.

Type of Drive

The basic types of drives can be identified as follows: *Hydraulic cylinders*—for direct movement, using piston shaft end or for indirect operation through a mechanical rocker arm or rack and pinion arrangement. Hydraulic cylinders are ideal for furnaces requiring automatic work movements at separate locations in sequence. Pullout, quench and other lateral movements are examples additional to the primary work movement through the heating chamber. In this type of setup all of the cylinders operate from a central pump and oil reservoir hydraulic package unit.

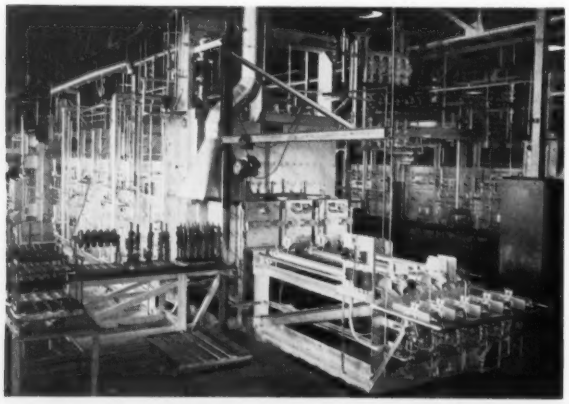


Fig. 1—Gas carburizing furnace with individually controlled direct acting hydraulic cylinders, in right foreground, that push trays straight through the heating chamber on skid rails. Note side charge position of work trays.

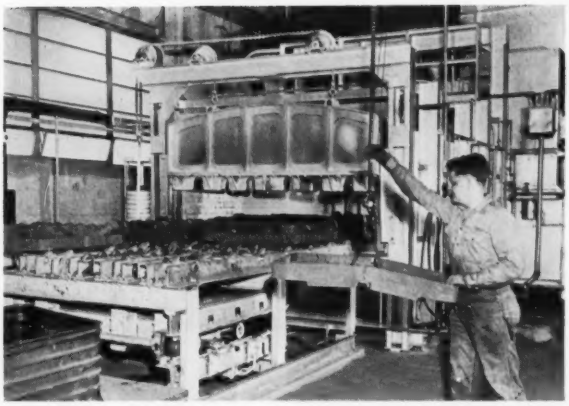


Fig. 2—Hydraulic pusher cylinders on this direct fired cycle annealing furnace are located below the work handling level and actuate dogs that engage the work trays or fixtures.

For direct pushing, the cylinder piston arm is equipped with an end plate or dog that contacts the work tray or basket and moves it forward to the end of the stroke (See Fig. 1). After the return stroke, the next basket is advanced into position, either by a hydraulic puller or by hand, and pushed forward against the previous basket to the end of the stroke. This procedure continues, at specific intervals, holding the work in each temperature zone for the required length of time. An additional hydraulic cylinder at the discharge end can pull the baskets straight out or through the side of the furnace. The entire cycle of operation preceding the charge-push is automatic and integrated.

Oscillating motion can also be obtained indirectly from a hydraulic cylinder through rack and pinion and rocker arm mechanisms. This type of arrangement, which places the cylinders below the work handling level, (See Fig. 2) permits straight through movement of the work trays or baskets from charge tables extending in front of the furnace charge door and well beyond the discharge door. It also permits overhead handling of the work or fixtures and allows

ready accessibility of the loads by the operator from all directions. Although the direct pushing cylinders are less complicated, they also necessitate side charging of the loads which is not always ideal for all types of work.

Air cylinders can be used for many of these arrangements, particularly where strokes are relatively short and loads light. The ever present shop compressed air systems can be utilized and where necessary oil "cushions" used to prevent thermal shock and smooth out the stroke. (See Fig. 3)

Electric motors actuating mechanical rack and pinions and rocker arm assemblies are often used when air or hydraulic cylinders are not desired. Customer preference often enters into these considerations. The rack and pinion is ideal for exceptionally long strokes or large cumbersome parts that are handled individually. However, the trend is now toward the use of hydraulic cylinders instead of electric motors for most pusher furnace applications.

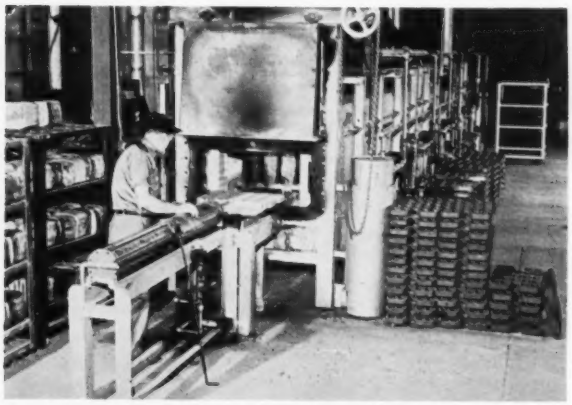


Fig. 3—The air cylinder on this direct fired furnace has an oil "cushion" that prevents thermal shock and assures a smooth steady stroke.

Method of Work Loading

Movement can be accomplished in a basket, tray or other fixture or by piece-to-piece, direct contact of the parts being heated.

Piece-to-Piece or direct contact of parts is used primarily for high temperature processing or in high thermal head furnaces. Pushing parts in this manner, on water-cooled skid rails, requires considerable force to accomplish movement but is necessary since moving parts such as rails, rollers, etc., will deteriorate rapidly at the high temperatures encountered. Muffle tubes, single or multiple, and V-notch hearths are often employed for accomplishing direct contact of piece-to-piece part movement for processing at lower temperatures and for small parts.

Baskets, Trays and Fixtures are utilized in pusher furnaces processing small parts in a variety of sizes and shapes. For short furnaces, medium loads and controlled atmosphere processing the trays are pushed on skid rails, (See Fig. 1) since alloy moving parts deteriorate rapidly under continual exposure to

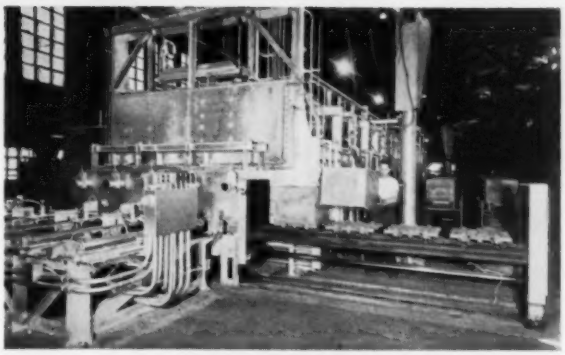


Fig. 4—Pusher type controlled atmosphere malleablizing furnace utilizing work trays that are equipped with rollers. Furnace is 90 feet long. Note hydraulic pusher cylinders in this 4-row furnace and side charge arrangement.

controlled atmosphere gases. This arrangement minimizes operating costs by reducing the amount of high temperature alloy requiring replacement. By only replacing trays it is not necessary to shut down the furnace to remove costly alloy parts.

Work processed in heavier loads and longer furnaces that do not utilize controlled atmospheres, can be pushed through the heating chamber on roller rails that extend beyond the charge and discharge doors (See Fig. 2). This arrangement, with pusher mechanism under the roller rails, permits work tray access from all directions and straight through movement of the work from outside the furnace. Deterioration of the alloy rollers and rails is minimized where controlled atmospheres are not used.

For exceptionally long cycles requiring controlled atmospheres, such as in certain types of malleablizing, the rollers are attached to trays and this roller-tray pushed through the furnace along grooved tracks. (See Figs. 4 & 5) The exceptionally heavy loads usually encountered in continuous malleablizing require the aid of these rollers in order to minimize the amount of pushing force required.

As in the continuous carburizing furnaces, this

Fig. 5—Interior view of the malleabilizing furnace in Fig. 4. Note grooved tracks for the rollers of the work trays and gas fired radiant tube heating elements overhead.

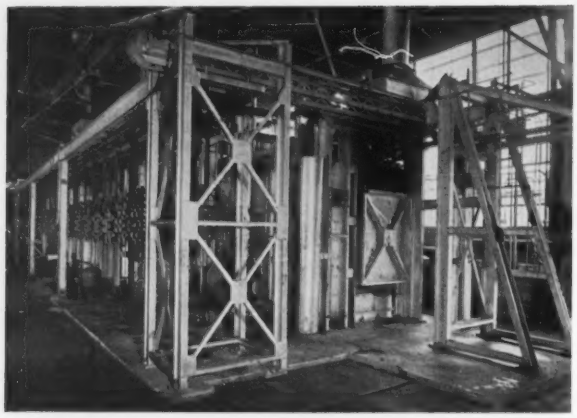


Fig. 6—A hydraulic cylinder is used in this overhead type hardening furnace to push crankshafts through the furnace. Cylinder is located overhead to the right of the furnace charge door.

arrangement permits continual operation of the furnace since only trays and rollers are replaced. This replacement is in turn minimized by lubricating with graphite and regular inspection of all roller-trays before each charge. In this manner breakdowns in the furnace can be prevented and down time minimized.

Overhead or Vertical Handling is used for certain types of parts, such as the crankshafts shown in Fig. 6, which must be heat treated in a vertical or hanging position for best results. In cases of this type, hydraulic pusher cylinders are placed overhead and the parts suspended inside the heating chamber from fixtures that are outside the heating chamber. Parts heat treated in this position often require a quench while in the same position, to minimize distortion.

Advantages of the Pusher Design

Although pusher type furnaces are not preferred for short cycle processing or where rapid emptying is required, their work movement through successive controlled oscillating motions provides extreme flexibility in application. Cycles can be repeated accurately. Action is positive and length and timing of stroke can be varied for a wide range of cycles, as required.

The oscillating mechanisms on pusher type furnaces are always outside the heating chamber, remote from the deteriorating high temperatures. The only heat resisting alloy requiring replacement are trays and work fixtures or in certain lower temperature applications, some rollers and roller rails.

Job-lot production is possible in a pusher type continuous furnace where overall production volumes are large enough. A good example of this is a 2-row radiant tube gas carburizing furnace now operating in one of the leading midwestern automotive gear manufacturing plants. In this plant it has been found that, counter to prevalent thought on gas carburizing, it is practical to carburize on a job-lot basis in the pusher type of continuous controlled atmosphere furnace. This is true when cumulative production rates are sufficiently high; it is not necessary to rely only on mass production runs to profitably utilize the definite advantages of continuous gas carburizing.

The flexibility within each row, (See Fig. 7) and between the two rows of this 3-zone furnace permits simultaneous gas carburizing of single large scale runs and small lots, lots that often consist of only one gear. Since movement of each row of work is individually controlled, several processing cycles can be carried out at the same time. For example—a 50-minute push time or a 9-hour 10-minute cycle will yield a .039 inch case depth; while a 75-minute push time or 13-hour 45-minute cycle will result in a case depth of .072 inches on the same .20 carbon carburizing steel.

A number of different steel analyses and a variety of part sizes and shapes are carburized in a single row at the same time. It is a simple matter to either press-quench or direct-quench the material in this row in any sequence desired by the operator. In Figure 7, a typical charge is being readied for entry into the purge vestibule for the first push into zone one. This illustration also shows some of the fixtures utilized for pinions and for large and small ring gears. The pinions will be direct-oil quenched in a hooded tank while the ring gears will be press quenched. After removal from the oil quench, the gears are cleaned in a two-station washer located immediately adjacent and parallel to the gas carburizer.

The entire facility, furnace, quench tank and washer, is 42 feet long and 23 feet wide with push-button controls conveniently located at central points for easy operator access. All hydraulic controls are also centralized on compact panels at charge and discharge ends in order to minimize piping and also provide for speedy maintenance.

The pusher type of furnace can also be readily adapted to fully automatic or the production-line type of operation. A good example is a new pusher tray furnace that cycle anneals universal joint forgings under fully automatic operation. Trays are loaded, pushed through the heating chamber, dumped and empty trays returned to charge end for reloading, all in a continuous sequence that is entirely automatic.

▪ ▪ ▪

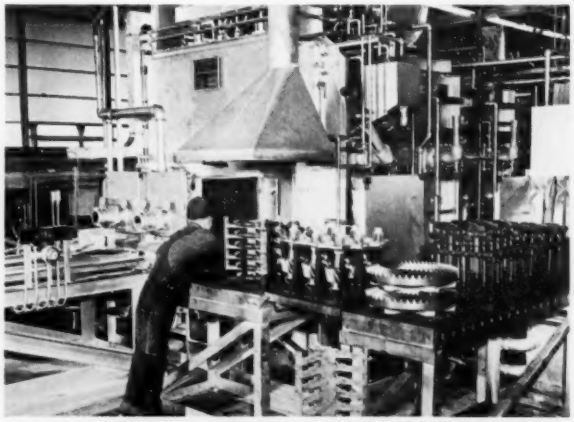


Fig. 7—A two-row pusher type gas carburizing furnace being used for job-lot production of automotive gears. Note variety of gear shapes, and sizes being charged. By varying speed and timing of individually controlled hydraulic cylinder strokes a variety of steel analyses and range of case depth are obtained.

By C. O. Knierim, Manager
Furnace Division, The Gas Machinery Company
Cleveland, Ohio

Roller Hearth Furnaces

The main advantage of the roller hearth furnace over other types of "straight-through" furnaces is that there is no carryout of heat from the furnace as is the case with belt or chain conveyor types. This feature, of course, results in a saving on fuel. Handling costs are kept to a minimum because the work may be loaded onto the charging table by means of extended conveyors and in most cases can be discharged automatically. Temperatures can be controlled in a number of zones to give various types of heating rates. These furnaces can be fired directly or heated by convection. Where certain conditions require the use of special atmospheres to protect the work against oxidation or decarburization, they are heated electrically or with radiant tubes using gas or oil for fuel. Cooling zones can also be utilized to obtain accelerated or retarded cooling to meet certain specified metallurgical conditions.

Recent Developments

Until recent years the capacity and temperature of the roller hearth furnace were limited due to the use of alloys for rollers and radiant tubes. To overcome this, The Gas Machinery Company developed a patented silicon carbide roller mounted on a water cooled shaft. This type of roller can operate at temperatures as high as 2600°F. and still carry heavy hearth loads. In conjunction with this, a silicon carbide radiant tube was perfected for use where special atmospheres are required. These tubes can be fired with any type of gas or light fuel oil. These developments have enabled heat treating plants and departments to enter new high temperature fields.

General Design

The basic design of the roller hearth furnace consists of roller shafts mounted on suitable bearings attached to the furnace casing. Each roller has an individual drive sprocket which engages a continuously driven roller chain. This chain, in turn, is connected by means of suitable gearing to a variable speed drive unit. The ratio of hearth speeds may range from 3 to 1 up to 10 to 1 depending upon the particular application.

Removable cover plates are provided on one side of the furnace so that rollers may be replaced without having to shut down the furnace. On direct fired fur-

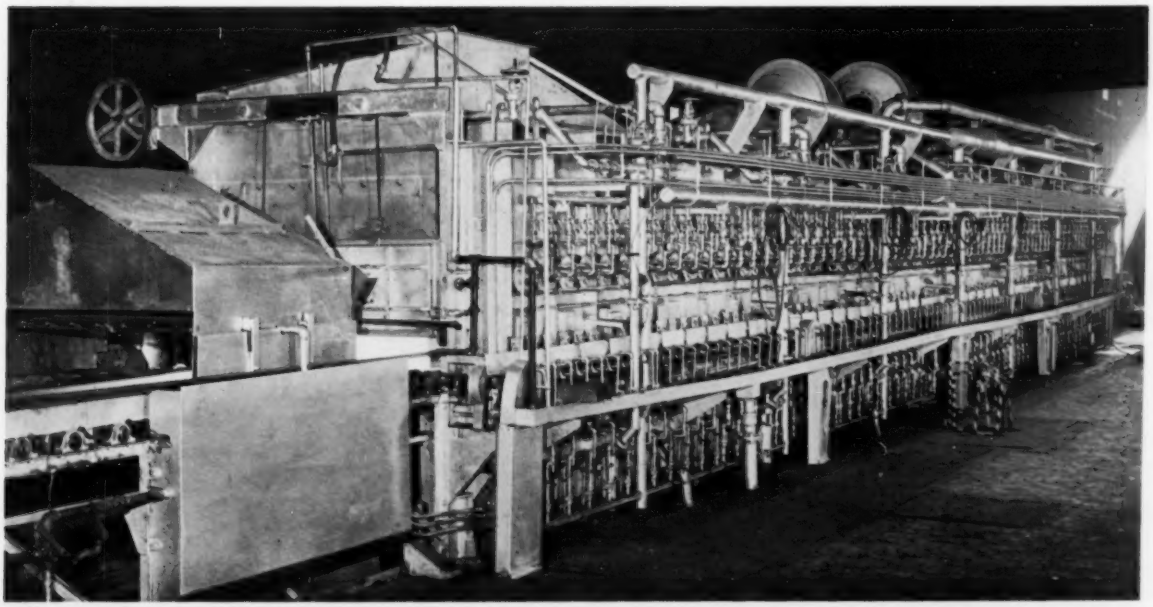


Fig. 1—Cross-fired roller hearth furnace for annealing stainless steel sheet. Hearth is 5'-6" wide, 70' long; operating temperature 2050°F.

naces an adjustable door is provided on each end of the furnace to reduce heat losses.

Where an atmosphere is required in the furnace that would become explosive if mixed with the proper quantity of air, a double door is provided at each end forming a purge chamber. This eliminates the explosive hazard but requires the use of electrical interlocks and signal devices such as electronic eyes to indicate to the operator when the work is ready to be discharged.

Applications

Fig. 1 shows a large stainless steel sheet annealing furnace that is cross-fired with silicon carbide radiant tubes and utilizes silicon carbide rollers. After installation of this furnace, the customer stated that manpower requirements were reduced by 60% over their old method. Sheets are annealed within two points of hardness without surface defects. Pickup on the rolls, which causes marking of the sheet, was eliminated by the use of silicon carbide rollers.

Fig. 2 shows a roller hearth furnace in which the tubes run longitudinally. This provides a greater rate of heat at the charge end and also results in keeping the furnace length to a minimum. The furnace illustrated is used for annealing stainless steel tubing. Typical performance data, based on operation of this furnace, is as follows:

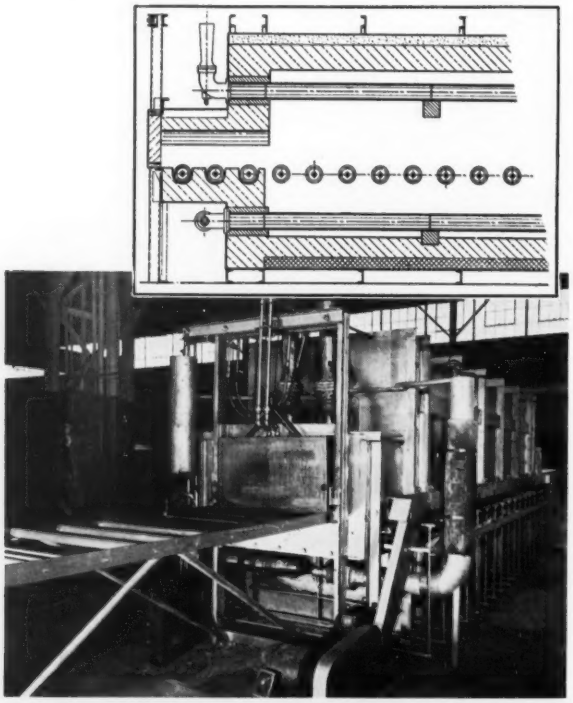


Fig. 2—Longitudinally-fired roller hearth for annealing tubing. This equipment replaced batch type furnace previously used for this work. Hearth is 2'-6" wide, 15' long. Schematic diagram shows arrangement of the four radiant tubes.

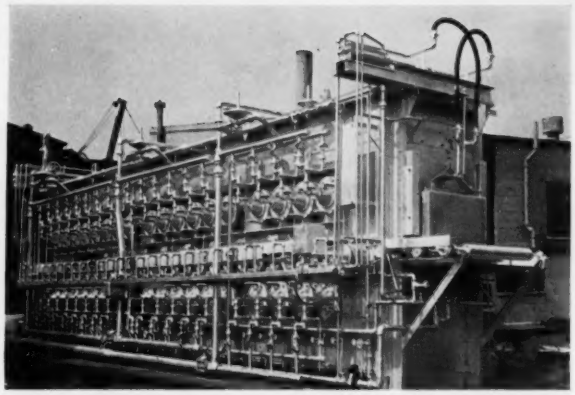


Fig. 3—This roller hearth furnace is for the sintering of powder metal parts; operates up to 2400°F.

	Batch Type Gas-Fired Furnace	*Roller Hearth Furnace*
Tons annealed	2435	467
Manhours	9652	832
Tons per manhour	0.252	0.562
(Manhours per ton)	3.96	1.78
Furnace operating hours	4826	832
Heating rate—lb./sq.ft./hr.	9	30
Average fuel cost per ton	$2.93	$1.86

In the majority of cases, roller hearth furnaces are built to the customer's individual requirements. Typical of the variety of applications for this type furnace is that shown in Fig. 3. It is used for sintering powder metal parts and incorporates silicon carbide radiant tubes and rollers. ■■■

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation, Export Distributors: Bethlehem Steel Export Corporation

Three types of tool steel solve most hot-work problems

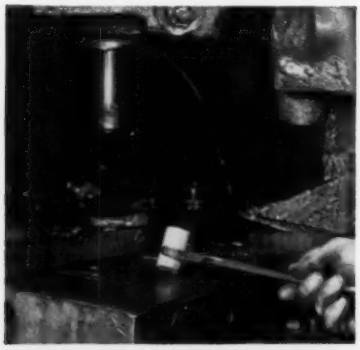
Hot-work tool steels which contain large amounts of either tungsten or molybdenum have high "red-hardness." In other words, they withstand very high operating temperatures without softening.

Although these steels have excellent wear-resistance, they cannot be subjected to drastic water-cooling while in operation because this results in excessive "heat-checking." Caused by repeated thermal stress, this condition shortens their service life. The 8½-pct-molybdenum type (our Hot-Work 8) is better in this respect than the 9-pct-tungsten type (our 57 Hot-Work).

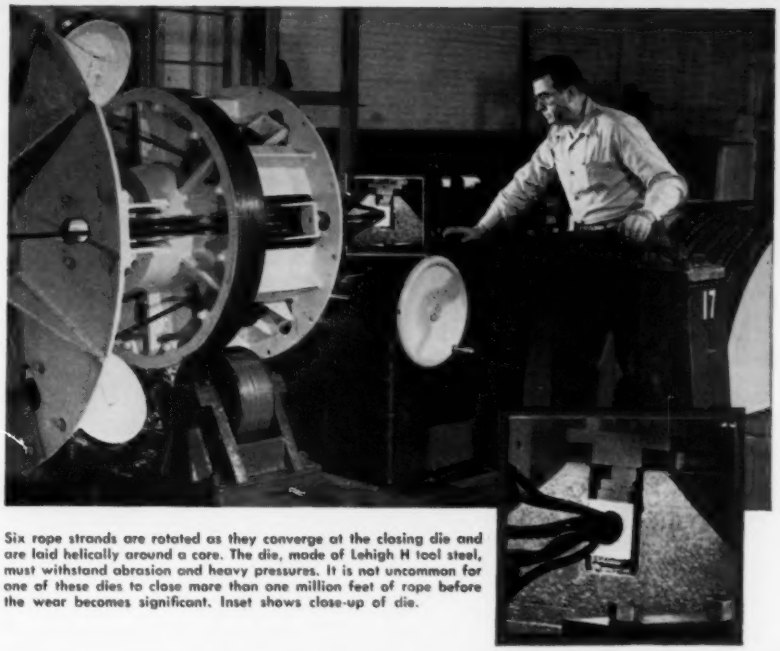
One way to prevent excessive temperature build-up, in repetitive operations where water-cooling is not used, is to provide duplicate tools which can be used alternately in the operation. This arrangement makes possible a longer cooling time between operations than if only one tool is used.

Whenever the nature of the hot-work operation is such that water-cooling of the tool is practical, it is often best to use one of the 5-pct-chromium types of hot-work steel—such as our chrome-moly-tungsten (Cr-Mo-W) and chrome-moly-vanadium (Cr-Mo-V) grades. The cooling prevents loss of hardness due to high temperature.

Although they have lower red-hardness, the 5-pct-chromium grades are good choices for tools and dies which involve both shock and hot-metal contact.



Operated in a 400-ton press, this punch is made of Bethlehem Cr-Mo-W tool steel. It extrudes steel slugs heated to 1950 F in the making of rock bits.



Six rope strands are rotated as they converge at the closing die and are laid helically around a core. The die, made of Lehigh H tool steel, must withstand abrasion and heavy pressures. It is not uncommon for one of these dies to close more than one million feet of rope before the wear becomes significant. Inset shows close-up of die.

Wire rope "closed" by long-wearing dies of LEHIGH H tool steel

One of the vital steps in the making of wire rope is the "closing" operation which arranges the rope strands compactly in a helical position around a core of either hemp or steel wire.

Closing dies are subject to considerable abrasion by the rotating strands as they converge at the die and pass through, at the same time being laid into accurate position. Lehigh H is ideal for this application because its high-carbon, high-chromium composition gives it extreme long-wearing properties. When the dies eventually become worn, they are usually refinished for use in closing rope of a larger diameter.

Made in two pieces, closing dies are machined to accurate size, heat-treated to a hardness of about Rockwell C-61; then they are ground and polished to avoid damage to the wearing surfaces.

Because of its air-hardening characteristics, Lehigh H is subject to only the minimum amount of distortion during heat-treatment—an important feature wherever accuracy is essential.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Avoid sharp-cornered keyways

Keyways with sharp corners are the cause of many shaft failures. Fundamentally, this type of breakage is a fatigue-failure due to excessive stress-concentration at the sharp corners.

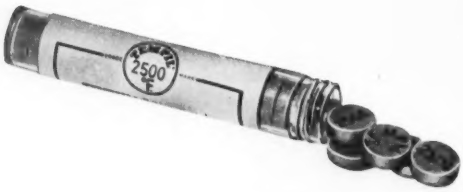
The cure for failures of this kind is to make keyways of half-round design and use a round key in the assembly.

Of course, the fact that stresses are low often prevents the failure of shafts with square keyways; and so this design continues to be used. But that does not alter the fact that a square keyway on a shaft is a basic design fault.

News to Heat Treaters...

New Developments In Temperature Indicators

TEMPILSTIKS°, TEMPILAQ° and TEMPIL° PELLETS for 413°, 425°, 438°, 463°, 475° and 488°F. are now under development and are expected to be available at the time of the Metal Show. This range is of particular interest in preheating for welding, tempering of tool steels, shell molding and a number of other important industrial applications. Including the newly developed items TEMPIL° products are now available in 12- or 13-degree steps from 113° to 500°F.



plus the recently added 525°F. rating, and in 50-degree steps from 550° to 2000°F. In addition TEMPIL° PELLETS are also manufactured for the temperature range from 2050° to 2500°F. inclusive.

The TEMPIL° CORPORATION of 11 West 25th Street, New York 10, N. Y., will exhibit its line of temperature-indicating materials in Booth #841 at the National Metal Exposition and Congress in Cleveland, October 19-23. The TEMPIL° technique of determining attained temperatures will be demonstrated on heated workpieces.

New Induction Heating Generator

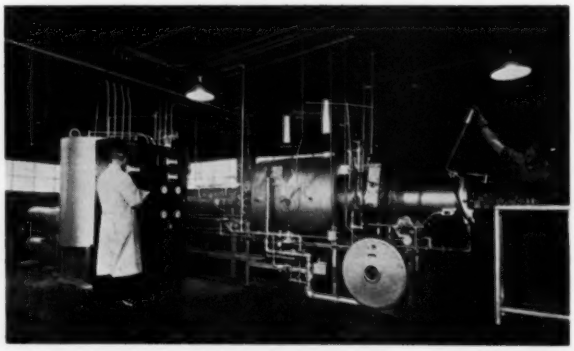
A new induction heating generator is available from Reeve Electronics, Inc., 601 W. Lake St., Chicago 6, Ill. The unit, designated Reevelec Model L6H, is a 25KW single station generator equipped with an automatic indexing work table.

The equipment shown in the accompanying photograph is used for annealing the rims of air brake chambers and operates on 230 or 460 volt, three phase current. It requires approximately 50 KVA power input at 90% power factor. The unit shown is equipped to handle a total of nine different sized chambers with a production rate of five to twelve seconds per part. The work table and generator are interlocked in such a manner that heating is automatically controlled

when the magnetic chuck turn table indexes the part to its proper heating position. Two heating positions are provided for pre-heat and final heating. Parts are manually loaded but automatically discharged.

Iron Lung for Metal Patients

In the past, heat treating of stainless steel has often made the metal "ill," as well as the heat treater, by turning a part either black or dark green through oxidation. Cures such as pickling, sandblasting, etc., often aggravated this illness by a tendency to disturb the balance of alloying elements.



The General Metal Products Co., St. Louis, purchased an "Iron Lung," informally named because of its resemblance to the famous medical unit from

(Continued on page 14)

the same everywhere...

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Great pains are taken to ensure that all Crucible REX High Speed Steels are uniform. Every scientific test known is used to make certain that all materials conform exactly to Crucible's high standard of quality. And only *Crucible* makes REX High Speed Steels.

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DEVINE AGITATORS

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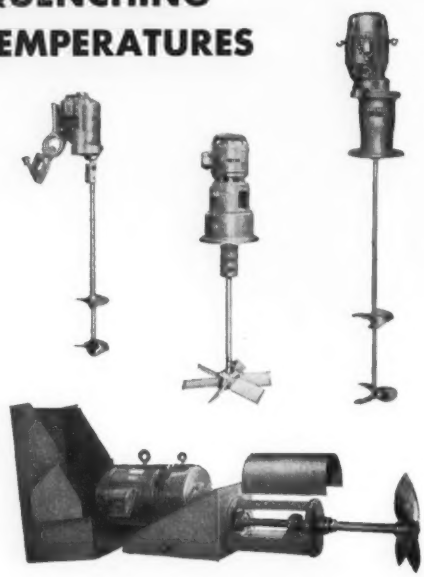
UNIFORM QUENCHING TEMPERATURES



- Provide proper circulation of quenching liquid.
- Help equalize quenching strains.
- Compact. Self-contained. No piping required.
- Unusually sturdy. Built for plenty of use.
- Easy to install. Easy to detach. Easy to maintain.

Devine Engineers will be glad to recommend a type and size to fit your tank.

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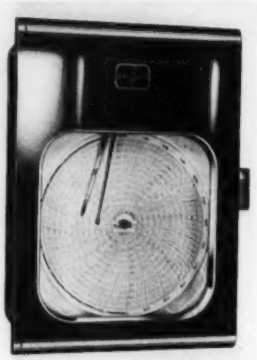
Devine AGITATORS

News to Heat Treaters (cont.)

Lindberg Engineering Company of Chicago to cure their patients—baskets of partially completed, deep-drawn stainless steel stampings of the type 305, 18-8. This furnace is also used to heat treat stainless steels in the 400 series. The unit is a full muffle, gas-fired hydrogen atmosphere furnace with a water-jacketed cooling chamber.

Doctors' reports from this plant showed an immediate improvement in the color of the patients, each stamping emerging from the "Iron Lung" treatment bright and scale free with their original sparkling finish.

New Line of Electronic Controllers Announced by Bristol



A new line of Free-Vane Electronic Controllers has just been announced by The Bristol Company, Waterbury, Connecticut. The new instruments are part of the Series 500 line, and are available as indicating or recording controllers for temperature, pressure flow, liquid level, humidity and time program control. They use the standard Bristol measuring elements.

Based on a unique frequency modulation principle, the Free-Vane Controllers are offered for low-open, high-open, low-high, low-open-high or low-normal-high control, as well as proportional input control.

Various combinations of one or two recording pens or indicators with one or two control units in one case make the new controllers adaptable to a wide range of control problems.

Heat Treating Plant Acquired

The A. F. Holden Company has purchased the physical assets of the Cook Heat Treating Corporation, 5934 Alcoa Avenue, Los Angeles 58, California. These assets include 45 furnaces for all types of industrial and commercial heat treating applications plus sandblasting, vapor blasting facilities, testing equipment and four delivery trucks.

The business will be managed by Cook Heat Treating, Incorporated, a Nevada corporation, as a wholly owned subsidiary of the A. F. Holden Company. The entire personnel numbering 55 people are being retained. The directors of Cook Heat Treating, Incorporated are:

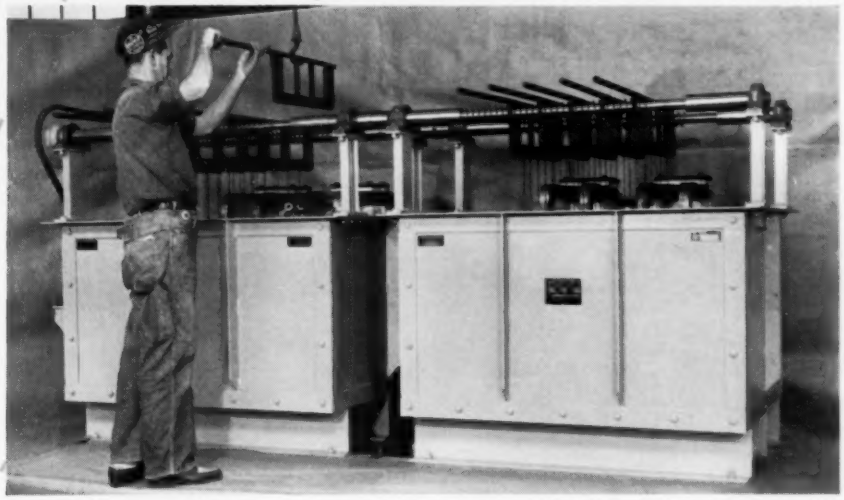
H. G. Howell ..... *President*
G. A. Zellmer ..... *Vice-Pres. & Gen. Mgr.*
J. B. Carey ..... *Vice-President*
A. F. Holden ..... *Treasurer*
J. Phillip Nevins ..... *Secretary*

H. G. Howell has served in executive capacities

(Continued on page 16)

HOUGHTON SALTS

give you Versatile, High Speed, Precise Heat Treatment



Versatile

Houghton Liquid Salt Baths cover a temperature range of 350° F. to 2400° F. for drawing, martempering, annealing, quenching, carburizing, nitriding, normalizing and hardening of both ferrous and non-ferrous metals.

High Speed

Liquid salts bring parts up to heat faster than is possible by radiation because the thermal conductivity from salt to metal is much higher than from air to metal. And because all atmosphere is excluded from the metal, decarburization and other surface problems do not occur and following surface treatment is not necessary.

Precise

Because temperatures of liquid salts can be controlled within two to three degrees, you can get the same close tolerances in your heat-treating as you demand from your machine shop. And you can get it batch after batch, week in and week out because Houghton Liquid Salt Baths are pure and double-refined for stability.

Ask your Houghton Man about Salt Bath Heat Treatment—he's had a lot of experience in servicing salt baths and will be glad to help you, too. In the meantime, write for your copy of Houghton's Liquid Salt Bath Catalog. E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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BROACHES,
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DIE SINKERS
DRILLS,
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- Multiple Spindle
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GEAR MACHINERY,
- Cutters
- Generators
- Grinders
- Hobbers

GRINDERS,
- Centerless
- Cylindrical
- Drill
- Gear
- Internal
- Knife
- Radius
- Surface
- Tool & Cutter

HAMMERS,
- Board Drop
- Helve

HEADERS
JIG BORERS
LAPPING MACHINES
LATHES,
- Automatic
- Chucking
- Precision

MILLERS,
- Cams
- Plain, Horiz.
- Production
- Duplex
- Thread
- Universal
- Vertical

NIBBLERS
PIPE THREADERS
PLANERS,
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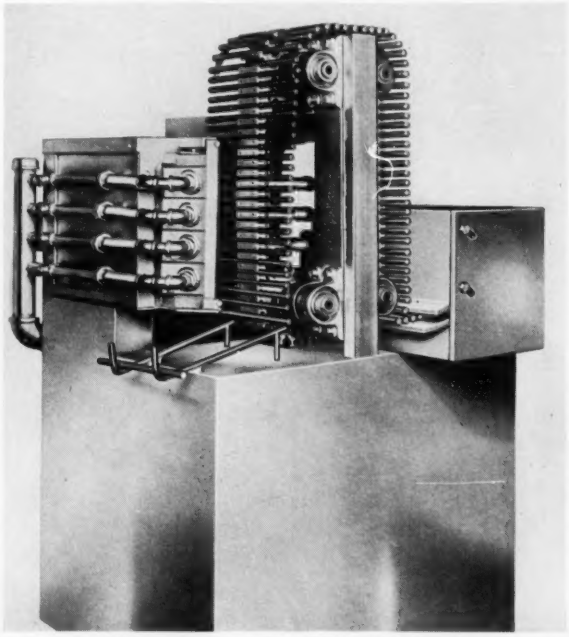
with E. M. Jorgensen Company of Los Angeles, General Motors Corporation in Michigan and Ford Motor Company in Canton, Ohio. G. A. Zellmer has been a resident of Los Angeles for thirty years. During this time his efforts have been devoted to the heat treating of metals. He was with the prior corporation in an executive capacity for twelve years. J. Phillip Nevins is an attorney, associated with Lawler, Felix and Hall, Standard Oil Building, Los Angeles, California.

The A. F. Holden Company operates plants at Detroit and Milford, Michigan, New Haven, Connecticut, Los Angeles, California; manufacturing salt baths, electrode furnaces and conveyors.

New Furnace for End Heating

Gas Appliance Service, Inc., 1211 Webster St., Chicago, Ill., has designed a new end heating unit.

Using production figures based on heating a 4" end-section of ½" rod, the new unit is said to bring rod to 1900°F., in 50 seconds, with an hourly production of 900 rods on the model illustrated. Similarly,



a ¾" rod reaches the same temperature in 75 seconds with hourly production of 600 rods. Designed with conveyor and automatic hopper feed, it is said to handle stock sizes of rod from ¼" to 1½" diameter, with varying number of burners to satisfy the particular stock and production to be handled. Length of section heated may be up to 4", and over-all length of pieces 6" to 24".

This new unit will be exhibited at the forthcoming Metal Show in Cleveland in the Public Auditorium, October 19 through 23.

(Continued on page 24)

HOLDEN ELECTRODE FURNACES

LEASE VERSUS PURCHASE

HOLDEN METALLURGICAL PRODUCTS

Lease benefits:

1. No capital investment.
2. Totally expensed from operating profits.
3. Complete write-off of wiring costs over term of lease.

TYPE 401-4
Marquenching-Austempering Unit

TYPE 701-4
Submerged Electrode Furnace with removable electrodes.

BENEFITS OF MARQUENCHING AND AUSTEMPERING:

1. Less distortion. **2. Improved wearing properties.**
3. Improved physical properties.

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HOLDEN MARQUENCHING #296 **WORKING RANGE 295°F.**

1. This new salt contains a coagulating material which separates out chlorides.
2. Your melting point and quenching rate can be maintained under any production operating conditions.
3. Any sludges are easily removed as soft residual material.
4. This product can be used in Holden Marquenching units and competitive furnaces.

IMPORTANT: We can supply our Marquench Additive #356 which can be added to your present salt quenching furnace as a separate item as a coagulant. Therefore, you can buy the coagulating material for competitive quenching salt baths and similarly add the new Holden Marquench #296, which will definitely eliminate your throwing away the quenching salt, and at the same time, obtain more uniform quenching.

Three f.o.b. points: Detroit, Michigan—New Haven, Conn.—Los Angeles, Calif.

THE A. F. HOLDEN COMPANY

P.O. Box 1898
New Haven 8, Conn.

3311 E. Slauson Ave.
Los Angeles 58, Calif.

11300 Schaefer Highway
Detroit 27, Michigan

Sound advice...

"LOOK-before you LEAP!"

Only the Co

And

If you are considering plans for expansion of present heat treating facilities or new plant construction, "Look Before You Leap" —check with an MTI commercial heat treater.

The chances are that you will find a Commercial Heat Treater near your plant with the facilities, equipment, skill and experience to perform "custom-tailored" heat treating operations required for your prime or sub-contract rearmament program work.

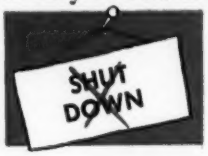
Eliminate Personnel Problems

All members of the Metal Treating Institute are specialists with complete service facilities under one roof. They offer you a variety of skills — handling and processing all types of heat treating from simple stress relief to delicate controlled atmosphere hardening, cyaniding, etc. This experience and know-how would be practically impossible for you to duplicate under today's conditions.

Avoid Future Waste

The recent post-war years proved the wisdom of using established facilities in your locality. Many expanded plant departments and new construction had to stand idle or be scrapped when the crisis passed. It is good business to avoid possible repetition. Remember, even if only Government money is involved at the present time, you will pay part of the cost eventually. Conservation of Government spending is always of benefit to you.

METAL TREATING INSTITUTE



A Good Policy

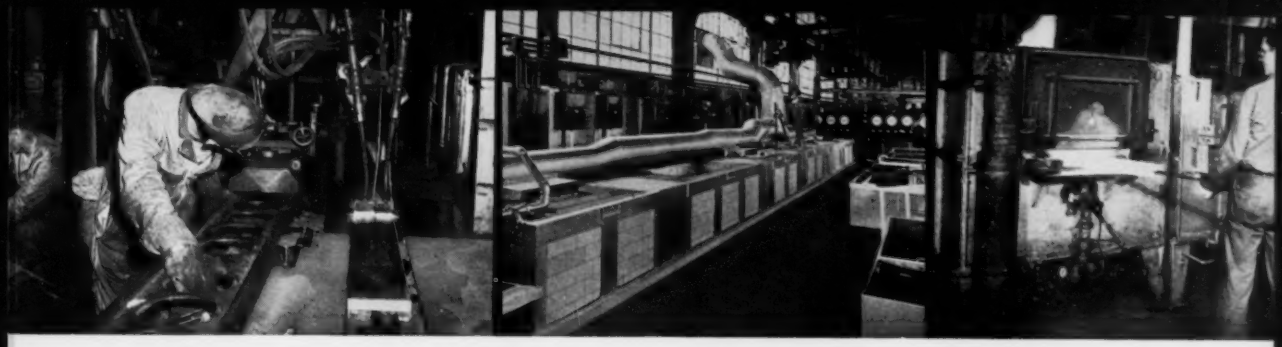
When faced with heat treating problems, or the need for heat treating services, contact the Metal Treating Institute or any MTI member listed on the facing page. All detailed inquiries receive prompt attention.

National Trade Association

COMMERCIAL HEAT TREATERS

METAL TREATING INSTITUTE

271 NORTH AVENUE — NEW ROCHELLE NEW YORK



ercial Heat Treater Can Give You COMPLETE Service . . .

ere's a Heat Treating Specialist Near Your Plant!

ALABAMA

Southern Metal Treating Co., Inc.
3131 10th Ave., North, Birmingham 4

CALIFORNIA

California-Doran Heat Treating Co.
2850 E. Washington Blvd., Los Angeles 23
Hollywood Heat Treating Co.
1046 No. Orange Drive, Los Angeles 38
Lindberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23
Cook Induction Heating Co.
4925 East Slauson Ave., Maywood
Dexter Metal Treating Co.
1026—77th Ave., Oakland 21
Industrial Steel Treating Co.
1549—32nd St., Oakland 8

COLORADO

Metal Treating & Research Co.
4110 Fox St., Denver 16

CONNECTICUT

Commercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
Stanley P. Rockwell Co.
296 Homestead Ave., Hartford 5

ILLINOIS

Seneeca Heat Treating Co.
70 S. Batavia Ave., Batavia
Accurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
Chicago Steel Treating Co.
333 North California, Chicago
Dura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
Lindberg Steel Treating Co.
222 North Laflin St., Chicago 7
Pearson Industrial Steel Treating
5757 Ogden Ave., Chicago 50
Perfection Tool & Metal Heat Treating Co.
1740 West Hubbard St., Chicago 22
Fred A. Snow Co.
1942 West Kenzie St., Chicago 22
American Steel Treating Co.
P. O. Box A, Crystal Lake
Eklund Metal Treating, Inc.
721 Beacon St., Love Park
O. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford
C. U. Scott & Son, Inc.
1510 First Ave., Rock Island

INDIANA

Nerl Heat Treat Corp.
1824 So. Franklin St., South Bend 23

MARYLAND

Maryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

New England Metallurgical Corp.
9 Alger St., South Boston 27
Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43
Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Acme Steel Treating Co.
119 Lieb St., Detroit 7
Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

MINNESOTA

Metallurgical, Inc.
900 East Hennepin, Minneapolis 14

MISSOURI

Metallurgical, Inc.
1915 Tracy Ave., Kansas City 8
Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Heat Treating Co.
611 Grove St., Elizabeth
American Metal Treatment Co.
Highway 25 and IaFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Steel Treating Co.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12
Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Metro Heat Treat Corp.
466 Broome St., New York 13
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E., Rochester 5
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Cincinnati Steel Treating Co.
Wooster Pike & Mariemont Ave.,
Cincinnati 27
Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
1265-71 East 55th St., Cleveland 14
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14
Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16
Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher
J. W. Rex Co.
834 West Third St., Lansdale
The Drever Company
220 West Cambria St., Philadelphia 33
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 East Mermaid Lane, Philadelphia 18
Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32
Ferrotherm Company
4911 Butler St., Pittsburgh
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11

WISCONSIN

Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wesley Steel Treating Co.
1301-1403 West Pierce St., Milwaukee
Harris Metals Treating Co.
1635 Murray Ave., Racine

Institute News . . .

REGIONAL MEETING HELD IN PITTSBURGH

Twenty-four representatives of 13 member companies attended the recent Regional Meeting held in Pittsburgh on August 21st. All gathered at the plant of President Al Cox where they made a short tour of Pittsburgh Commercial Heat Treating before driving to the New Kensington plant of the Aluminum Company of America.

Alcoa was host to the group for luncheon served at the plant. Mr. Patterson, Works Manager, and several guides joined the group for luncheon where the members were divided into smaller groups before going through the plant. All had an opportunity to see most areas of the plant including melting shops, annealing furnaces, extrusion presses, plant heat treating department, roll and press shops. New Kensington produces a wide variety of products from structural shapes to foil, cigarette wrapping paper, pie plates and pots and pans.

At the Hotel William Penn, the members were guests of President Cox for cocktails and dinner, after which an extremely interesting talk was given by Mr. Patrick J. McCarthy, Supervisor of Tool Standards Department, Aluminum Company of America.

Mr. McCarthy's subject covered the Air Force Heavy Press Program but he also touched upon the work of the SAE and their attempts to reach standardization in the designation of tool steels.

Some of the facts and figures given by Mr. McCarthy regarding the Heavy Press Program were of real interest. For example, he described air hardening a ram 25" in diameter and 9' long. All were impressed by the magnitude of various castings and forgings used in these presses, most of which had to be heat treated to meet design specifications. The meeting concluded with an open discussion on costing methods for the heat treatment of bar stock. Members in attendance were:

Anderson Steel Treating Co., Detroit, Mich.
C. G. Anderson — A. G. Anderson

Bennett Steel Treating Co., Newark, N. J.
Melvin Dressen

Commonwealth Industries, Inc., Detroit, Mich.
C. R. Weir

Commercial Metal Treating, Inc., Bridgeport, Conn.
Mike Kober

Dayton Forge & Heat Treating Co., Dayton, Ohio
Charles H. Hewitt

Lakeside Steel Improvement Co., Cleveland, Ohio
C. W. Derhammer — C. R. Derhammer

Metlab Co., Philadelphia, Pa.
Conrad Knerr — Charles Brown

Ohio Heat Treating Co., Dayton, Ohio
L. J. Schriml

Pearson Industrial Steel Treating Co., Chicago, Ill.
L. P. Josephs

Pittsburgh Commercial Heat Treating Co., Pittsburgh, Pa.
A. M. Cox — Cliff Howard
Elmer Cox — M. E. Ramsey
Thomas E. Sims — Mr. Howe

Reliable Metallurgical Service, Inc., Cleveland, O.
G. H. Griffiths — Don Steele

Standard Steel Treating Co., Detroit, Mich.
Colin S. Kidd

Syracuse Heat Treating Corp., Syracuse, N. Y.
J. R. MacAllister

Metal Treating Institute
C. E. Herington — J. J. Codella

ANNUAL MEETING

As this issue goes to press, final preparations are being made for the 1953 Annual Meeting at the Hotel Carter, Cleveland, Ohio, on October 16th, 17th and 18th. Complete coverage of the meeting will be given in our next issue and copies of the minutes will be prepared for those members who expressed a desire to have them.

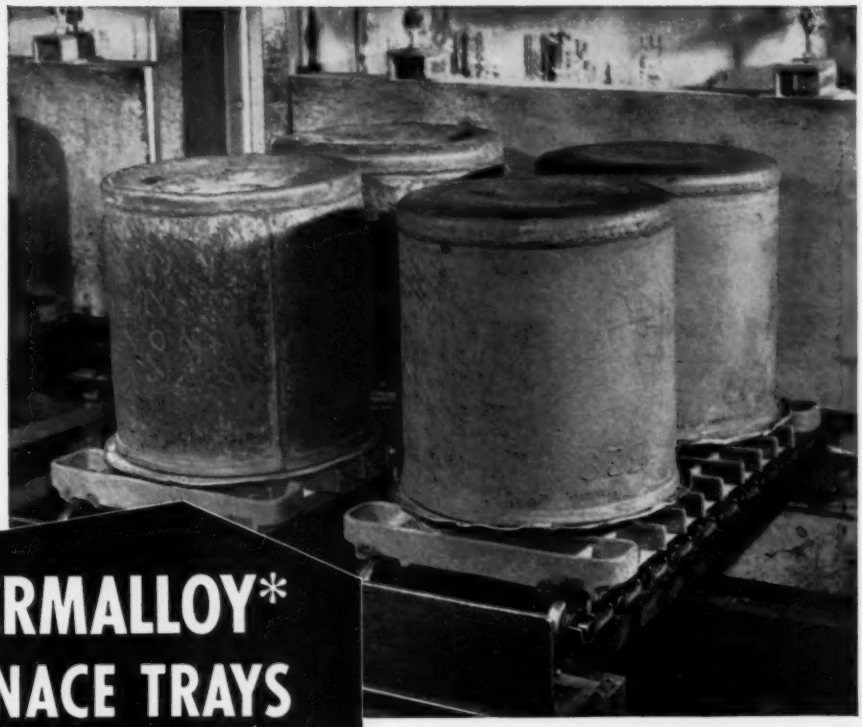
Highlights of this year's meeting will be talks by technical speakers on the subjects of Pressure Nitriding and Heat Treating Costing. Several Round Table Discussions will be held on a number of subjects including Methods of Determining Heat Treating Costs and Should the MTI Undertake a Research Program. Two new films are also scheduled to be shown and visits to the plants of several Cleveland members have been arranged.

ALFRED HELLER

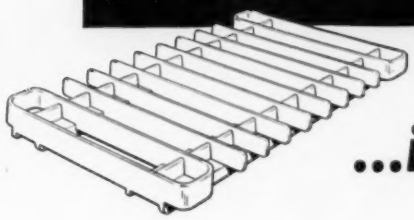
Alfred Heller, founder and President of the Alfred Heller Heat Treating Co., Inc. of New York City, died on August 26th at the age of 64. Prior to establishing his own company in 1932 Mr. Heller was mill superintendent of the Lackawanna Steel Co. and later Vice-President and metallurgist of the Hercules Steel Co. He was a graduate of Stevens Institute of Technology.

For the past three years Mr. Heller had devoted himself to his hobby of raising begonias at his home in Rockland, Maine where he had assembled one of the finest collections in the country.

(Continued on page 22)



THERMALLOY* FURNACE TRAYS



...in service over 10,000 hours!

A large automotive parts manufacturer "pack-carburizes" drive pinions in pots conveyed two on a tray through a gas-fired furnace where temperatures range up to 1700°F. Previous designs of the furnace tray cracked, warped and scaled quickly, with average service life limited between 100 and 600 hours.

This manufacturer asked Electro-Alloys engineers how service life of these trays could be extended. Electro-Alloys designed a new furnace tray . . . cast it in a grade of heat-resistant Thermalloy best suited for long carburizing service. Two years ago, these Thermalloy trays were installed. Today, with over 10,000 service hours each, they are still in use.

Thermalloy is not one alloy but a group of alloys—each developed to meet specific high-temperature operating conditions. Electro-Alloys produces many types of high heat-resistant Thermalloy castings such as muffles, retorts, trays, fixtures, baskets, rollers. In many cases too, Electro-Alloys engineers can help you redesign your heat-treating parts in Thermalloy to give more operating hours per dollar. Call your nearest Electro-Alloys representative for full information or write Electro-Alloys Division, 4003 Taylor Street, Elyria, Ohio.

Write for new Thermalloy Tray and Fixture Bulletin T-226.

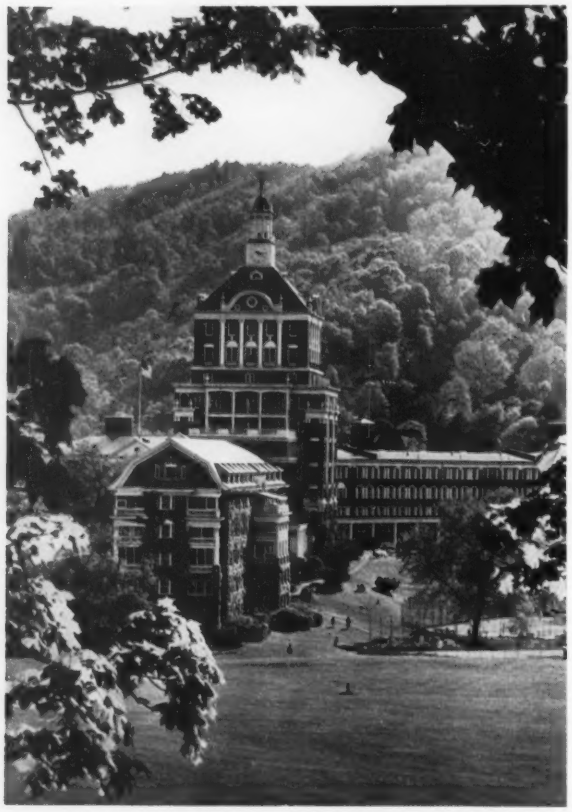
*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

1954 SPRING MEETING TO BE HELD AT THE HOMESTEAD, HOT SPRINGS, VA.

A majority vote by the membership resulted in the selection of The Homestead, Hot Springs, Va., as the site of the 1954 Spring Meeting. The Homestead is situated in the Allegheny Mountains of Virginia and offers a wide variety of diversions among its 17,000 acres. It can be reached by automobile or the Chesapeake and Ohio Railway and there is also an airport operated by the resort, which will be of interest to at least one member. Reservation cards will be mailed to all members around the first of next year. No effort will be spared to make this coming meeting as successful and thoroughly enjoyable as the previous meeting in Houston.



The Homestead, location of next year's Spring Meeting.

MEMBER CITED AS OUTSTANDING BLOOD DONOR

Mr. George H. Porter III, of George H. Porter Steel Treating Company, was recently commended by the City of Cleveland as an outstanding blood donor during both World War II and the Korean conflict. To date he has donated a total of forty pints of blood. Active in the Cleveland Association of Purchasing Agents, Mr. Porter will address the national group immediately prior to attending the Annual Meeting of the MTI.

PEACE AND PRODUCTION

The following item, condensed from The Wall Street Journal and reprinted by The Reader's Digest, was forwarded by Mr. C. H. Muehlemeyer of the O. T. Muehlemeyer Heat Treating Company, Rockford, Ill. It needs no prologue, and we agree with Mr. Muehlemeyer in his feeling that it should have wide circulation.

Would Peace Mean Depression?

It is an absurd philosophy to believe that prosperity is made by Government spending and that if war spending stops the prosperity will collapse.

It is quite likely, of course, that if, and when, international tensions are eased, there will be some decline in our spending for war. But to conclude that this will be bad for a nation's economy is idiotic.

Less Government spending makes possible a lesser tax burden. The Government will spend less money on goods useless for anything except destruction, and the citizens will have more money to spend for economically useful goods. Such soft spots as there are now in the economy are in consumer goods which the people, robbed by taxes and inflation, have not enough money to buy.

If it were true that a nation could be made prosperous by putting a large part of its national product into arms, we could get more and more prosperous by taking more and more men away from useful work and putting them into uniform; by taking more and more of our machines out of useful production and putting them into production of things to be blown up. The bigger the armies the less we would have to worry about unemployment; the bigger the war the less about "surplus productive capacity."

If this idea made any sense we could do the whole thing much more simply. We could hire half the population to make balloons and the other half to explode them with pins, and the resulting level of employment and economic activity would be stupendous.

The truth is that a war economy is destructive. It brings inflation and inflation in its worst form spreads chaos and poverty. The war economy is destructive even if it blows nothing up, for it makes useless the work of vast quantities of men and machines.

Any promise of peace is a harbinger of a richer prosperity, for peace is the essential soil for all economic progress. It has been only the periods of peace that have made this nation strong enough and prosperous enough to survive all its wars and, unlike so many other nations, emerge afterward not bankrupt.

War is a terrible thing, but more terrible yet is the fact that there are men who talk of peace as if *it* were terrible.

(Reprinted from The Reader's Digest, July 1953. Condensed from The Wall Street Journal, March 21, 1953.)

MEMBER COMPANY SOLD

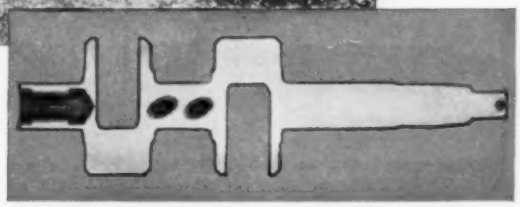
The A. F. Holden Company, Detroit, Mich., has announced the purchase of Cook Heat Treating Corp., 5934 Alcoa Ave., Los Angeles, Calif. Further details are given in the News to Heat Treaters section of this issue. Mr. W. W. Farrar, former owner, is now operating Valley Metal Treating Corp. in Pomona, Calif.

The Evinrude Story:

Salt bath treatment improves product . . . reduces cost in crankshaft production

Savings in machining and grinding operations, due to reduced distortion, are greater than the entire heat treating cost!

Evinrude's new Super Fastwin 15-h.p. outboard motor.



EVINRUDE CRANKSHAFT—Carburize in Park-Kase 1 for 2¾ hours at 1750°F. Case Depth .045". Transfer to Park Nu-Sal Neutral Salt at 1450°F. followed directly by Iso-thermal quench in Park's Therm-Quench Salt.

AT Evinrude Motors, they combine Park-Kase liquid carburizing and Iso-thermal quenching and tempering into one continuous operation . . . with all processes performed in the same furnace line.

The crankshafts are immersed in Park-Kase liquid carburizer to produce the desired case . . . then transferred to Park Nu-Sal neutral salt at above the critical before the Iso-thermal treatment in Park Thermo-Quench Salt.

RESULTS: a hard case covering a tough core! Valuable production time is saved! But that's not all—

- Less distortion allows less final machining
- Metallurgical properties of part improved
- Process does not require skilled help
- Operate either manually or mechanically
- High capacity per unit of floor space
- Low investment per unit of production

The results are the same at Evinrude as they are wherever Park salt baths and technical assistance is used: quality is improved . . . production is increased . . . manufacturing costs are lowered!

Second in a series of advertisements describing Park processes on the job.

• Liquid and Solid Carburizers • Cyanide, Neutral, and High Speed Steel Salts • Coke • Lead Pot Carbon • Charcoal • No Carb • Carbon Preventer • Quenching and Tempering Oils • Drawing Salts • Metal Cleaners • Kold-Grip Polishing Wheel Cement

Park

PARK CHEMICAL CO.

8076 Military Avenue • Detroit 4, Michigan

☐ Send for free bulletin on Deep Case Liquid Carburizing.

Name_____ Position_____

Company_____

Address_____

City_____ State_____

ROLOCK

FABRICATED HEAT AND CORROSION RESISTANT ALLOYS

LEFT: Parts entering roller hearth furnace on "Serpentine" trays.
BELOW: "Serpentine" trays on loading table.

"SERPENTINE" DESIGN *minimizes* WARPAGE...

LOWERS HOUR-COSTS FOR FURNACE TRAYS AT

PRATT & WHITNEY AIRCRAFT

Rolock "Serpentine' furnace trays are carrying jet engine parts through a Westinghouse roller hearth furnace with an Exothermic atmosphere at maximum temperature of 2050°F.

Rolock quoted on another type of tray as well as the "Serpentine," but 100 "Serpentine" trays were purchased for original equipment and have so far had many months of continuous use . . . with additional orders placed during that time.

The exclusive Rolock Serpentine construction gives freedom to expansion and contraction in both directions, minimizing warping to a greater degree than any other furnace tray Rolock has seen. It is available to order in any practical length, width and depth . . . as a tray or as the base of a basket or crate.

Rolock engineers invite your requests for solution of specific metal treating problems. Our experience covers hundreds of nationally known industrial plants.

HEAT TREATING . . . OR CORROSION RESISTANT CATALOGS ON REQUEST.

See ROLOCK at Booth 2011, METAL SHOW, October 19-23, Cleveland, Ohio

Offices in: PHILADELPHIA • CLEVELAND • DETROIT • HOUSTON • CHICAGO • ST. LOUIS • LOS ANGELES • MINNEAPOLIS • PITTSBURGH

ROLOCK INC. • 1232 KINGS HIGHWAY, FAIRFIELD, CONN.

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

4RL538

News to Heat Treaters (cont.)

New Equipment Firm

Formation of the Bryant Industrial Products Corporation and its purchase of the principal assets and production facilities of the Bryant Industrial Division, Affiliated Gas Equipment, Inc., has been announced by Robert M. Buck, president of the new Cleveland enterprise.

The new firm, to specialize in the design, production and marketing of industrial gas combustion equipment, will be located at 17700 Miles Ave., Cleveland, after July 2. All key personnel of the former Affiliated Gas Equipment division will join in the new organization.

According to Mr. Buck, plans for the immediate future include the expansion of present product lines and the development and introduction of several new lines, as well as broadened engineering and sales activities.

Officers of the new company, in addition to President Buck, are Lawrence R. Foote, vice-president, and John Sellers, Jr., secretary-treasurer.

Government-Owned Inventions Available for License

To encourage industry—particularly smaller plants—to take advantage of the fruits of Government-financed research, the U. S. Department of Commerce, in cooperation with the Government Patents Board, has made available in practical form information relating to 3,658 Government-owned patents.

The information is in a book entitled, "Government-Owned Inventions Available for License," just published by the Commerce Department so that greater productive use might be made of the scientific and technological advances brought about at Government expense.

The inventions are arranged by fields of industrial use to facilitate the location of the patent or patents which may meet special needs, and are classified under 20 major industrial groups which are further divided into 211 subgroups. The major groups and subgroups are described and the patents applicable to each

subgroup are listed in chronological order. As an invention may have various uses and be classified under more than one subgroup, there are 5,817 listings in the publication. Each listing includes the patent number, the title of the invention, the name of the inventor, and the Government agency administering the patent.

"Government-Owned Inventions Available for License" may be purchased at the field offices of the Department of Commerce or directly from the Government Printing Office, Washington 25, D. C. for $1.00 a copy.

Salt Bath Developments

More than 4,000 manufacturers of metal products have installed modern electric salt bath furnaces to perform a wide variety of heat-treating processes, according to L. B. Rosseau, vice-president, Ajax Electric Company, Inc., Philadelphia, who presented an illustrated talk on this subject at the Cincinnati Chapter of the American Society for Metals on September 10.

Among the salt bath furnace applications which have become common in the last ten years, according to Mr. Rosseau, are: 1. Neutral hardening of steels—without oxidation or scaling, and without adding to or subtracting from the carbon content. 2. Hardening of high-speed tools where temperatures as high as 2400°F. are needed but where surfaces must remain clean and free of imperfections. 3. Cyaniding to impart a shallow, file-hard case in a relatively short time. 4. Carburizing to add carbon to the steel's surface. 5. Interrupted quenching — austempering, martempering and cyclic annealing. 6. Solution heat-treating of nonferrous metals, particularly aluminum and copper. 7. Descaling and desanding with a minimum loss of the metal treated.

Mr. Rosseau said that the average salt bath furnace in 1952 had a connected load capacity of about 100 kilowatts, compared to 50 kilowatts in 1942. Salt bath furnaces range in size up to 40 ft. in length, 20 ft. in depth and 8 ft. in width.

FIRST with MECHANIZED Batch Type Heat Treating
YOU CAN DO MORE with METAL
because
DOW
FURNACES CAN BE EQUIPPED FOR . . . .
Normal Oil Quenching
Hot Oil Quenching
Slow Cooling In Atmosphere
Atmosphere Quenching
Isothermal Annealing
Atmosphere Tempering
Write today
. . . for literature or call and tell us your problem.
KE 2-9100
DOW FURNACE COMPANY
DOW FURNACE COMPANY
12045 WOODBINE • DETROIT 28, MICHIGAN

the tempers, as well as by subzero chilling are shown in the tabulation below. Typical analysis of the steel tested is C, 2.10, Cr, 11.50, V, .60.

These tests show that type D3 high-carbon high-chromium tool steel responds to the short-time, high-temperature quench in a manner similar to type D2 steel. However, it is noted that very accurate control of tempering temperature is necessary to obtain a hardness of C-63 minimum. If subzero chilling facilities are available the desired hardness can more easily be obtained. (Note that −100°F chilling in dry ice and alcohol is as effective as liquid nitrogen at −319°F). It should be noted that the complete range of temperatures useful in this short-time high-temperature type of treatment has not been explored. It should also be noted that tools treated by this

Tempering Temperature	Rockwell Hardness
None	C-55/58
920°F	62
930	64
940	61
950	60
1000	54
−319	66
−100	66
−319 and +400	64
−100 and +400	64

Table III—Hardness of D3 Tool Steel vs. Tempering Temperature

procedure have not been service tested as yet: whether improved wear resistance is obtained on type D3 steel by this treatment is not known.

Tests on Type A2 Air Hardening Steel

Type A2 tool steel, which is known as 5% Cr Air Hardening steel was also considered as being potentially capable of responding to the short-time, high-temperature quench. Preliminary tests showed that this was so, but that a hardness of Rockwell C-56 was as high as could be obtained by producing transformation by tempering. This hardness is too low to be of practical interest. However, if subzero chilling equipment is available, the following cycle will be of interest. (Rockwell Hardness results on 1 in. specimens are indicated after each step.)

Operation	*Hardness*
Preheat 1500°F (45 minutes)	—
Heat 2050°F (5¼ minutes) air cool	C-40/42
Chill at −100°F (1 hour)	C-62
Temper 350°F (1 hour)	C-60

Discretion should be used in the application of this cycle to type A2 tool steel since the subzero cool introduces some cracking hazard on intricate tools. It should also be noted that no service tests have been run on tools treated by this method and it is not now known whether improved wear resistance is produced by the high temperature quench on tools made of this grade of steel. ■■■

HEAT TREATING HINTS

Long Cycle Precipitation Hardening of "K" Monel

"K" Monel, a precipitation hardening alloy whose properties of high strength and excellent corrosion resistance have made it a desirable engineering alloy, may require long cycle heat treatment for certain applications.

The recommended times and temperatures for the precipitation hardening of this alloy may be found in the published literature of the manufacturer, The International Nickel Company. This data recommends a specific time and temperature for general use and usually, higher temperatures and shorter time cycles are suggested for the great majority of applications. However, it is important to note that almost all precipitation hardening alloys may be treated at lower than generally recommended temperatures, for longer time periods, to obtain the required physical properties of the alloy.

Complex fabrications require special treatment at lower temperatures.

In general practice, fabrications or weldments of "K" Monel are precipitation hardened by the use of comparatively high-temperature, short-time cycles. There are occasions, however, where the complexity of the part and the amount of working to which it is subjected before welding may cause the part to fail during the heat treatment. The reason for this failure is due to the low ductility of the metal adjacent to the weld area and the residual stresses caused by fabrication which may exceed the strength of the metal at the standard heat treating temperature.

At lower temperatures, i.e., around 950°F, the internal stresses of the part will not be as great in proportion to the strength of the alloy as at the usual heat treating temperature of 1080°F. It follows, however, that by using a lower temperature, the time cycle must be increased considerably to insure complete precipitation hardening of the alloy. In this particular instance, a 100 hour heating cycle is required at 950°F, followed by a slow cool (15°F/hr.) to approximately 800°F and subsequent air cooling.

The physical properties obtained through this treatment are identical to those developed by the standard practice of heating to 1080°F for 16 hours, slow cooling to 1000°F, holding 4 hours, slow cooling to 900°F, holding 4 hours, and air cooling.

Fred Heinzelman, Jr.
Fred Heinzelman & Sons
New York, N. Y.

Specify MITCHELL-BRADFORD *for your* HEAT TREATING *requirements*

HEAT TREATING SALTS

TYPE OF HEAT TREATING	PRODUCT	MELTING POINT	WORKING RANGE
TEMPERING	Quick Temper #275	275°F	300°F — 1000°F
	Quick Temper #310	310°F	380°F — 1100°F
	Quick Temper #420	420°F	500°F — 1100°F
	Quick Temper #850	900°F	1000°F — 1550°F
LIQUID BATH CARBURIZING	Free rinsing for light and deep cases	1100°F	1200°F — 1700°F
	Barium Base for light and deep cases	1075°F	1200°F — 1750°F
NEUTRAL SALT HARDENING	Neutral "C"	850°F	925°F — 1500°F
	Neutral "A"	1000°F	1100°F — 1750°F
	Neutral "B"	1200°F	1300°F — 1600°F
	Neutral "D"	1000°F	1100°F — 1700°F
	Neutral "H"	1500°F	1600°F — 1900°F
	Neutral "HH" (High Speed)	1700°F	1800°F — 2500°F
	Neutral "AS"	1000°F	1100°F — 1750°F
	Neutral "BS"	1200°F	1300°F — 1650°F
ALUMINUM HEAT TREATING	Quick-Al "A"	420°F	500°F — 1100°F
	Quick-Al "B"	590°F	650°F — 1100°F
NITRIDING	Quick-Ny #950	900°F	1000°F — 1200°F
	Quick-Ny #80	950°F	1050°F — 1300°F
AUSTEMPERING & MARTEMPERING	Quick-Mar #275	275°F	300°F — 1000°F
	Quick-Aus #420	420°F	500°F — 1100°F
BRAZING	Quick-Braze A	1800°F	1900°F — 2400°F

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Heat Treating Abstracts

Gear Heat Treating at Ford Instrument Co.

Helicopter transmission gears require a hard case and tough core to meet the heavy demands of supporting all the weight of the aircraft while in flight. For this application AMS 6260 (AISI 9310) steel is preferred, AMS 6252 (AISI 3310) is an alternate. After forging, parts are normalized and rough machined; they are then stress relieved and semi-finish machined. Prior to carburizing the gears are selectively copper plated, degreased and cleaned. Carburizing is done at 1700°F in L&N Homocarb furnaces with Microcarb control to maintain about 0.90% carbon in the hypereutectoid zone.

The gears are slow cooled after carburizing, then sand blasted and stripped of any remaining copper plate. After replating with a copper flash they are heated in a Westinghouse electric furnace with Endogas atmosphere. Gears are quenched from 1500°F to 1525°F using either expanding type dies or plugs. After hardening, gears are tempered at 300°F for four hours. Final case hardness is Rc 60 to 64, core hardness is Rc 36 to 40. After tempering, gears are inspected, copper stripped and routed to next operation.

(Abstracted from "Heat Treating Gears to Meet Rigid Requirements," by R. Spagnola, *Materials and Methods*, August, 1953.)

Gear Heat Treating at Greenlee Bros. & Co.

Induction hardening is successfully employed here for a wide variety of gear types and sizes. The majority are Cr-Mo steel of about 0.50 carbon; types are spur, bevel and helical; bores are either keyed or splined.

Due to the short runs and variety encountered, automatic setups are impractical, thus parts are manually handled. Manufacturing operations are: cut off stock, rough turn, heat treat to Rc 26, finish turn, broach hole, hob teeth, shave teeth, induction harden, rebroach bore, place in stock for assembly.

Experiments showed that a case of high hardness at the pitch line of a gear and about Rc 26 at the root led to early failure through fatigue at the root. Deeper hardening to a point below the root was found to provide the necessary strength to prevent this. Therefore, hardening and tempering to Rc 48 to 50 below root has been adopted as a standard.

Induction heating is performed on an Allis-Chalmers 50 Kw vacuum tube type heater using coils of single turn construction. After installing the correct coil, gears are placed on an adjustable work rest for centering. The heating cycle is automatically controlled to provide heat at hardening temperature to about ¼" below the root. Gears are manually quenched, then vapor degreased, tempered to Rc 48 to 50 in an air circulating furnace and sand blasted.

Distortion is held to a minimum with this treatment to the point that nothing further is done to the pitch diameter after hardening. All bores are rebroached even though it has been found that there is almost no movement in splined bores.

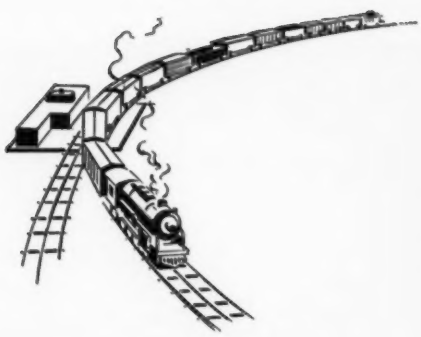
(Abstracted from "Induction Heating Helps Produce Better Gears," by L. G. Miller, *Metal Progress*, June, 1953.)

Gas Nitriding 4140 Steel

Recent research and practical application have shown that gas nitrided 4140 steel provides a number of advantages over the use of much harder Nitralloy steels for precision parts. Among these are: a tougher case, geometry is less critical, rounding corners is unnecessary, threaded holes need not be blocked off, less danger of grinding cracks after nitriding; plus the advan-

(Continued on page 31)

Tempilstiks°
quick, simple, accurate way to tell temperatures
use like a crayon
to control working temperatures in:
• welding
• flame-cutting
• tempering
• forging
• casting
• molding
• drawing
• straightening
• heat-treating in general
$2 each
gives up to 2000 readings
300°F
It's this simple: mark the workpiece with the proper Tempilstik°. When the mark melts, the specified temperature has been reached.
Available in these temperatures (°F)
113 125 138 150 163 175 188 200 213 225 238 250
263 275 288 300 313 325 338 350 363 375 388
400 450 500 550 600 650 700 750 800 850 900
950 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450
1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000
Also available in pellet or liquid form.
FREE —Tempil° "Basic Guide to Ferrous Metallurgy" — 16¼" by 21" plastic-laminated wall chart in color. Send for sample pellets, stating temperature of interest to you.
Metal & Thermit Corp. 100 E. 42nd Street, New York 17, N. Y.



Lionel is on the right track

Here is an Inconel pusher tray designed by ALLOY ENGINEERING COMPANY, Berea, Ohio. The Inconel basket being loaded on the tray (above) contains parts that will be sintered at 2050° F. Each tray is "double-stacked" to utilize furnace capacity.

Pusher trays, like those used at The Lionel Corporation in Irvington, New Jersey, take a two-way beating.

Here's what a daily grind those tough, oxidation and corrosion-resisting Inconel® trays go through.

First, they are loaded with two Inconel baskets holding twenty pounds of parts each. Then they start on the journey through the 1650 to 2050° F. furnace, pushing the tray behind. The furnace atmosphere is exothermic or endothermic reducing gas. They spend 35 to 40 minutes in both the pre-heat zone and the hot zone and then two hours in the cooling zone.

And they go through this cycle as many as five times a day for as long as 15 months without failure. **All they require is an occasional maintenance of welds and straightening. These trays are designed and fabricated by Alloy Engineering Co., Berea, Ohio.**

It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

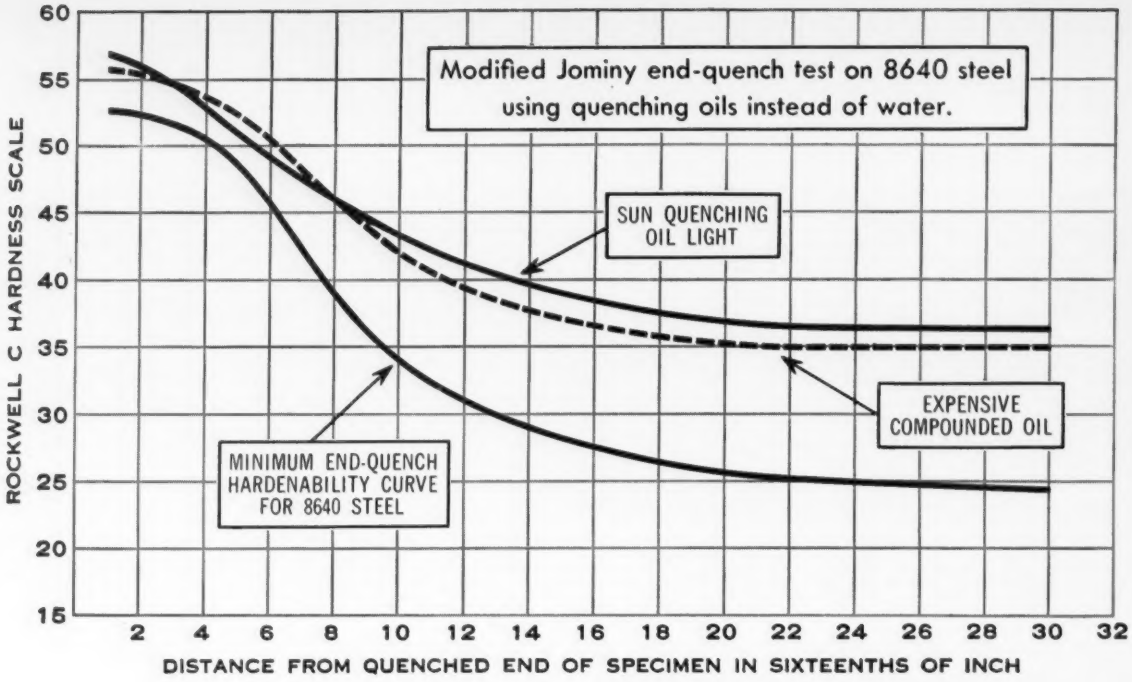
Write to Inco for your copy of an interesting booklet for the heat treating industry. Ask for "Keep Operating Costs Down . . . When Temperatures Go Up."

THE INTERNATIONAL NICKEL CO., INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK

Inco Nickel Alloys

Inconel . . . *for long life at high temperatures*



You can do 95% of all quenching jobs by using SUN QUENCHING OILS

This has been proved again and again in industrial heat treating departments and in the laboratory. The above test curves compare the results obtained from Sun Quenching Oil Light and those from an expensive compounded quenching oil. The hardnesses obtained are far above the commonly accepted minimum.

In addition to assuring consistently uniform physical characteristics, Sun Quenching Oils prevent sludge formation and help remove any deposits that may exist. Oil coolers are kept clean; maintenance costs are decreased. Sun Quenching Oils lower operating costs too. They thin out when heated, drain off parts faster and more completely. Make-up is materially reduced.

For more information about Sun Quenching Oils and how they can help you, call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. MR-9.

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SUN OIL COMPANY

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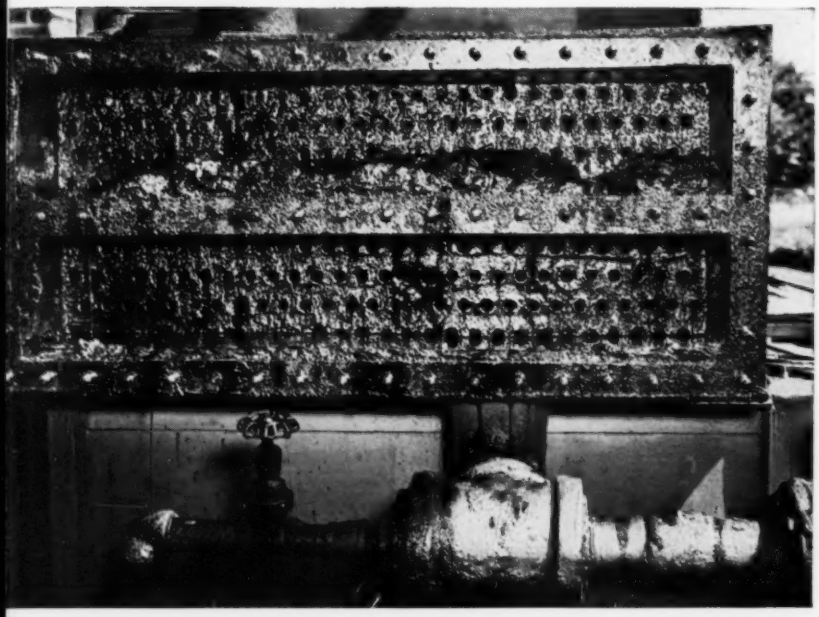
THIS PLANT QUENCHES ALL TYPES and sizes of automotive and aircraft forgings. Sun Quenching Oil Light serves all five of the 2400-3000 gallon systems. In the seven years the shop has been using this oil, no unit has been down except for normal mill scale removal.



AN OIL THAT FORMS SLUDGE CLOGS oil coolers, increases maintenance and operating costs. Sun Quenching Oils have a natural detergency which helps keep the systems clean and removes any deposits that may exist.

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tage of using a less expensive material.

Processing Cautions: Material must be handled in the same general manner as the Nitralloy steels. Failure to harden and temper before nitriding results in low impact strength. For example, nitriding, after hardening and tempering, provides Izod impact values of 20 to 30 ft. lbs.; while in the annealed state or after normalizing and drawing, and then nitriding, the impact strength falls well below 10 ft. lbs. Tests on 4140, 4150 and sulfurized Cr-Mn-Mo steels showed that hardening and tempering to higher hardness values (up to 320 Rc) before nitriding, results in a harder case with a consequent increase in impact strength.

Growth: 4140 grows somewhat more in nitriding than the Nitralloy steels. At 24 and 48 hour nitriding periods, the difference is negligible. For high precision parts longer times are generally not necessary, but if they are, a test piece should be run first.

Case Depths: 24 hours at 975°F will yield a case of about 0.012" with near maximum hardness to 0.0015" and good hardness to 0.003". 48 hours will produce about 0.017" case, maximum hardness to 0.003" and good hardness to 0.005". White layers run up to 0.0002" and 0.0004" respectively, for these times.

Application: A live head stock spindle for a grinding machine was nitrided for 48 hours, then ground true by removal of 0.0005" surface metal. After 2 years and 9 months service, inspection showed wear of only 0.0002" to 0.0008" over a very small portion of the bearing surface, surface finish had deteriorated from 4 to 14 microinches. This 4140 part was returned to the machine for further service; its condition was considered very good under the heavy service involved.

(Abstracted from "Gas Nitrided 4140 Case is Tougher," by J. G. Morrison, *Iron Age*, July 9, 1953.)

Salt Bath DIPPING BASKETS from Stock!

Don't carry an expensive inventory of special baskets when one of the stock sizes listed below will fill your needs.

Straight or offset handles—3/8" diameter perforations on 1" centers—Dependable Misco Heat Resisting Alloy

Following sizes ready for immediate shipment

Diameter	6"	6"	7"	7"	8"	8"
Depth	6"	8"	7"	8"	8"	12"

MISCO FABRICATORS, INC.

Designers, Builders, Fabricators of Heat Resisting Alloy and Stainless Steel Equipment

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TELEPHONE LORAIN 7-1545

WHAT'S YOUR PROBLEM?

ED. NOTE: Frequently *"Metal Treating"* is asked for answers to heat treating problems of various types. These are referred to technicians, metallurgists, etc. The correspondence below is typical.

Send us *your problem*—we'll try to get the answer and publish it for your benefit and others.

Gentlemen:

I received your paper "Which Surface Hardening Process" for which I am very thankful.

You write that if I need additional information to leave you know.

There are a lot of questions I would like answered. I am practically a beginner but I would like to make sure I am on the right track. Perhaps you can supply me with booklets or recommend booklets to me that might supply answers to beginners, and where they can be obtained.

I know what goes into Oil, Brine and Air, but what is the best method of handling. How long do you leave a piece in brine? Do you shake it? Do you put it also in oil? How do you toughen a piece of O.H.T.S.? How do you toughen a piece of A.H.T.S.? and others.

I have occasion to read your magazine sometimes but that usually has information for advanced Heat Treaters.

Yours sincerely,

FRANK A. EMHAUS
4247 N. Reese St.
Phila. 40, Pa.

Dear Mr. Emhaus:

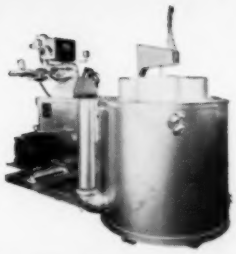
In answer to your letter of August 24th, the best advice we can offer you, if you wish to enter into heat treating on a career basis, is to undertake studies which will provide you with a basic knowledge of metallurgy. This can be done either at night school or at home through a correspondence course. For example, International Correspondence Schools offers a course on "Heat Treatment of Metals" which covers 23 lessons.

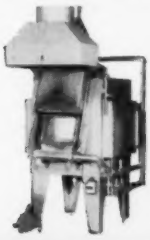
Enclosed is a copy of "Standards of Apprenticeship for the Heat Treater Trade" which will give you a good idea of the amount of work and study required to qualify as a skilled heat treater. As you can see from this, the most important thing is to arrange for a steady program, starting at the beginning of this subject in order to build a solid foundation of knowledge so

(Continued on page 34)

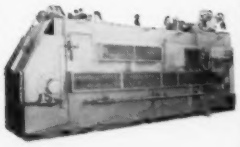
Conveyor brazing furnace

Batch tempering furnace





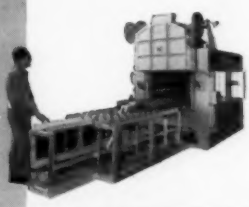
Controlled atmosphere hardening furnace (tool room)

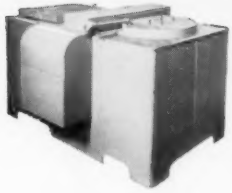


Controlled atmosphere conveyor furnace (production)

a complete line of heating and melting FURNACES

Production annealing and stress relieving furnace

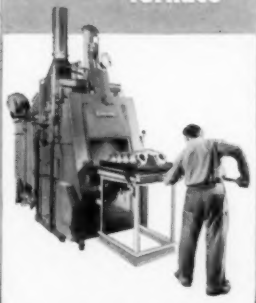




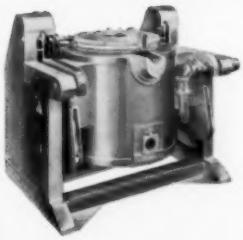
Lindberg-Fisher 2-chamber induction melting and holding furnace

High frequency induction heating unit

Carbonitriding furnace



Fisher melting and holding furnace (gas or oil fired)



Lindberg Engineering Company manufactures a complete line of industrial heat treating furnaces, industrial melting furnaces, laboratory equipment, and high frequency induction heating equipment. Lindberg Engineering Company, 2466 West Hubbard Street, Chicago 12, Illinois. Write for details.

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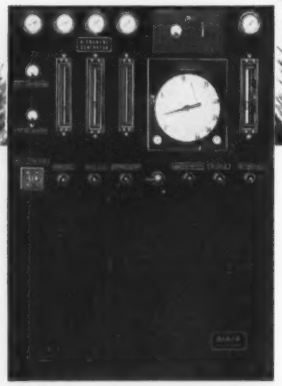

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. . . Produces pure nitrogen with a controllable hydrogen content that can be varied at will and maintained at any percentage from .25% to 25% to best suit work in furnace.

Used for bright annealing, heat treating, and furnace brazing of stainless steel, low and high carbon steels and non-ferrous metals.

- Fully Automatic
- No Operating Personnel Required
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LETTERS TO THE EDITOR

Dear Editor:

I have received your two copies of "Metal Treating" and am very well pleased with your magazine. I would like very much to receive it regularly. I am a Heat Treater at the San Francisco Naval Shipyard. Also a member of A.S.M.

109 Felton St. *JAMES A. LEARY*
San Francisco, Calif.

Dear Editor:

Would you please put my name on your mailing list to receive future copies of "Metal Treating."

I have just had the opportunity of looking through two old copies and find them filled with valuable information.

C. P. ZILLICH
Metallurgist
Amer. Brake Shoe Co.
AmForge Division
Chicago, Ill.

Dear Editor:

I would like to receive your publication, "Metal Treating," published every two months by the Metal Treating Institute.

I am a heat treater in the Aero division of the H. M. Harper Co.

A friend gave me a copy of "Metal Treating" which I found very interesting and informative.

I could find no subscription rates in the magazine so no money is enclosed. If there are subscription rates, please send bill to me and not to my employer.

My work is with Stainless Steels and high temperature alloys. Also the generation of Nitrogen atmosphere.

AUBERT J. LEMISE
H. M. Harper Co., Aero Div.
Morton Grove, Ill.

Dear Editor:

Gratifying results are being obtained from publicity releases about our product AJUSTO PROFILE TEMPLATE. Inquiries being received are helpful to us by creating direct sales as well as dealer interest.

We want you to know we appreciate your assistance and hope to make use of your services in the future.

Please note our new address and correct your records accordingly.

NORMAN T. FIREBAUGH
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MORE PARTS PER HOUR with General

FLEXIBLE-POWER STRAIGHTENING PRESSES

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DETROIT 11, MICH

What's Your Problem? (cont.)

that you can understand more advanced principles which you will come across later on.

We also strongly suggest that you carefully look over the "Manufacturer's Literature" sections of the trade journals you have access to. Here you will find pamphlets and books on all types of processes, materials and equipment. Many of them have been designed to offer an ABC approach on their subjects and should be of great help to you.

We hope these suggestions will be of help to you and wish you success in your efforts.

Sincerely,

C. E. HERINGTON
METAL TREATING

LP GAS INSTALLATIONS and ANHYDROUS AMMONIA PLANTS

More than 80 Peacock Plants prove . . .
"There's No Substitute For Experience"

PEACOCK CORPORATION
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Westfield 2-6258

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Brand New—At Reduced Prices

Size 30 x 30. Well-known manufacturer. Process superior to other metal surface treatments — new principle employed. Especially suitable for removing organic and inorganic coatings, plating, and heat treat scale. Replacement parts guaranteed.

$885 per 30 x 30 Cabinet Size Machine

Write Box No. 553

Manufacturers' Literature . . .

The literature listed below contains information of interest to heat treating organizations. For your copy write direct to the manufacturer and be sure you mention seeing it reviewed in "Metal Treating."

FURNACE AND INDUCTION BRAZING

The story of how furnace and induction brazing reduces costs, increases production, and achieves higher quality is told in a picture-story case-history technique in a new bulletin announced as available from the General Electric Company, Schenectady 5, N. Y.

Designated as GEA-5889, the 12-page, two-color booklet is the latest in the Company's series on modern metal processing. It employs over 30 photographs to explain how various types of brazing have proven more economical than former processes. Examples include cases where furnace brazing has replaced casting, forging, machining, and welding of parts; and where induction brazing has replaced torch brazing, soldering, and riveting.

* * *

TWO NEW BOOKS GIVE X-RAY ANALYSIS DATA

Two new books recently published as part of the Philips Technical Library are available at $2.00 each from the Research & Control Instruments Division, North American Philips Company, Inc., 750 South Fulton Avenue, Mount Vernon, N. Y.

Titled "Data for X-ray Analysis," Volume I (100 pages), by W. Parrish and B. W. Irwin, contains charts for solution of Bragg's equation (d versus ø and 2ø). Charts cover K Radiation for molybdenum, copper, cobalt, iron and chromium. Also included is a table that converts minutes into decibels of a degree.

Volume II (84 pages), by W. Parrish, M. G. Ekstein and B. W. Irwin, contains tables for computing the lattice constant of cubic crystals. Tables give K radiation values for the square root of N times wavelength divided by 2 for copper, nickel, cobalt, iron and chromium.

Volume II also contains a table giving $\sin^2 \phi$ values in 0.1 degree steps from 10° to 89°, a table giving values for $\frac{1}{2} (\cos^2 \phi / \sin \phi + \cos^2 \phi / \phi)$ in 0.1 degree steps from 10° to 88°, a table giving lattice constants of cubic substances, and a chart showing 33 representative cubic diffraction patterns.

* * *

FURNACE AND OVEN CONTROL INSTRUMENT CATALOG

A new catalog of control instruments for furnaces, ovens, dryers and kilns has just been published by The Bristol Company, Waterbury 20, Conn. The catalog, No. P1255, features Electronic Dynamaster potentiometer and millivoltmeter type pyrometer controllers, recorders and indicators. A wide variety of electric, air-operated, and electronic control instruments for use with fuel-fired and electric heating equipment of all types is listed. Complete engineering specifications and prices are given. In addition to numerous photographs, the catalog is liberally illustrated with diagrams of the various control arrangements and dimension sketches.

MANUALLY-OPERATED INDICATORS

Complete information about how manually-operated portable and panel indicators are being used to precisely measure temperature, electrolytic conductivity or pH is contained in a new 24-page catalog, "L&N Manually-Operated Indicators for Temperature, Electrolytic Conductivity and pH Measurements," just published by Leeds & Northrup Co., 4934 Stenton Ave., Phila. 44, Pa.

This publication fully describes the design and operating accuracy of these indicators which are direct reading in terms of the variable under measurement. A feature of this catalog is the convenient arrangement of instruments according to application. Circuit diagrams show how they operate. Choice of equipment is made easy by listing in tabular form all specifications for both the indicators and accessories. Besides pictures of each indicator, the catalog also contains typical installation photographs.

* * *

HOW CIRCUIT BREAKERS SAVE MONEY

The application of AB-1 circuit breakers to reduce downtime and maintenance is discussed in booklet B-5456 available from the Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa. Actual cases show how the replacement of fused devices by AB-1 circuit breakers result in improved continuity of operation.

Complete design and operating details are provided, and typical applications for each of the seven different types of enclosures are given. A basic selection-data chart for general purpose NEMA 1A sheet steel enclosures is provided as well as a downtime cost comparison sheet for circuit protection.

* * *

GRAPHIC CONTROL PANELS

The growing use of Panelgraphs in a broad range of industrial control applications is shown in a new bulletin, "Panelgraphs Throughout Industry," recently published by Panellit, Inc., 6312 N. Broadway, Chicago 40, Illinois.

The Panelgraph is a central control panel which utilizes visual aid techniques to present process information to the operator. It enables the operator to comprehend large masses of data, and react intuitively when required to keep the process functioning properly.

Pictured in the new bulletin are several typical Panelgraph applications in power stations, petroleum refineries, chemical and process industry applications. Various techniques of graphic symbolism are illustrated. Also shown are graphic panel components—control devices developed especially for this phase of process instrumentation.

INDUSTRIAL POWER DISTRIBUTION

A visual program which outlines the latest electric power distribution practices for industrial plants has been announced by the General Electric Company, Schenectady 5, N. Y. The presentation consists of a 35 mm sound slidefilm, a 28 page power distribution manual and allied literature. The twenty minute film called "The Vital Link," offers information on how to select economical unit substation sizes, what circuit arrangements fit specific needs, how to select and maintain proper voltages and what protective devices should be built into a power system. Explaining these matters in more detail is the illustrated manuel entitled "Industrial Power Distribution Idea Book," designated as GEA-5900.

* * *

NEW KLEM CATALOG DESIGNED TO AID METAL PROCESSORS AND FINISHERS

Klem Chemicals, Inc., 14401 Lanson Avenue, Dearborn, Michigan, announces a new catalog to aid in selecting correct chemicals for various operations. The catalog lists 33 standard Klem products and contains a comprehensive application chart for surface preparation of ferrous and non-ferrous metals. Klem's laboratory facilities for compounding special chemicals for unusual conditions have also been described in the catalog.

* * *

IMMERSION HEATERS

A new Electric Immersion Heater Catalog that features a section of application data for calculating the power requirements for heating processing tanks has been prepared by the Cleveland Process Company, 7016 Euclid Ave., Cleveland 3, Ohio.

The data simplifies the problem of estimating heat losses, determining the correct KW needed and selecting proper heater size for tank capacity. Fully described in the new catalog are two types of electric immersion heaters manufactured by Cleveland Process Company.

* * *

NEW FAN ENGINEERING MANUAL

Catalogue No. 20, a 64-page illustrated guide to industrial ventilation and air movement has been published by Aerovent Fan Co., Inc., 720 E. Ash Street, Piqua, Ohio. Engineering, installation and operating data for standard and special-duty fan applications are included. It covers full details and description of all Aerovent fans and accessory equipment.

HIGH SPEED HEATING FURNACES

A new bulletin just released by Surface Combustion Corporation, Toledo 1, Ohio, illustrates new equipment meeting current demands for high speed heating. This bulletin, SC-162, points up the advantages of high thermal head heating, with gas or oil, for press forging, upsetting, extruding, stress relieving of ferrous and non-ferrous metals. Basic furnace designs and burner arrangements are described in conjunction with the demands of overall or selective heating for semi-automatic or fully automatic production.

* * *

MULTI-POINT RECORDER

A new technical information sheet, TI 33-A-15A, issued by The Foxboro Company, Foxboro, Mass., describes the various combinations of control and alarm available with the multi-record Dynalog recorder. By adding simple Rotax (electrical) mechanisms, the electronic recorder can be made to actuate alarm systems and control process variables, in addition to continuously recording up to six measurements of temperature, flow or conductivity on a single chart. The factual sheet contains reference data on setting mechanisms, control circuit variations, relay ratings and specifications for Rotax circuits. Diagrams clarify each of the four control or alarm actions, showing typical circuits and their industrial applications.

* * *

HEAT TREATING EQUIPMENT

A four-page bulletin called the "Selector" has been published by the Stanwood Corp., 4819 W. Cortland St., Chicago 39, Ill. It describes and illustrates typical baskets, retorts, trays and fixtures for furnace loading and quenching. Typical uses are suggested for all of the fabricated items included.

* * *

HEATING ELEMENTS

A 20-page booklet has been published by the Globar Division of The Carborundum Company, Niagara Falls, N. Y. Booklet "H" covers Globar Elements in detail, giving their general properties, methods of control and atmosphere effects. Also included are specifications for various terminal straps and clamps. Complete physical and electrical specifications are given for installations with heating lengths varying from 4" to 66".

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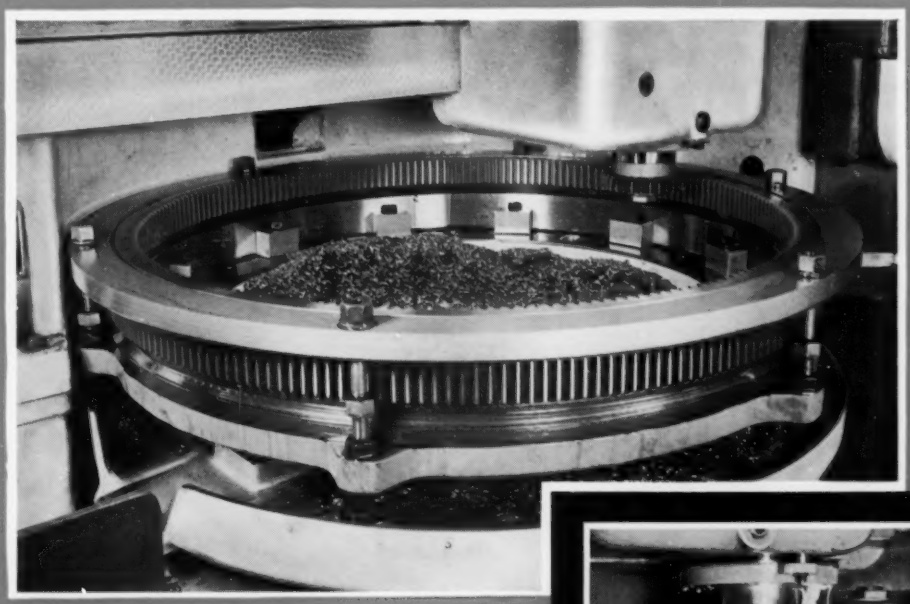
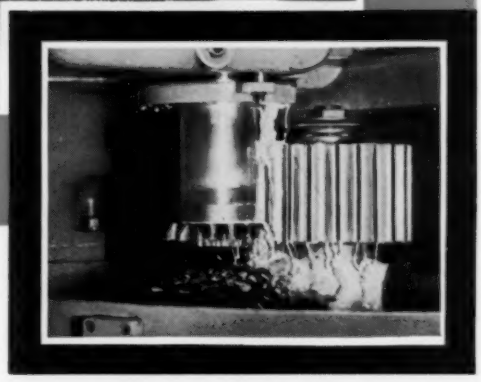


Fellows 36-type Gear Shaper set up to cut a heavy-pitch spur gear.



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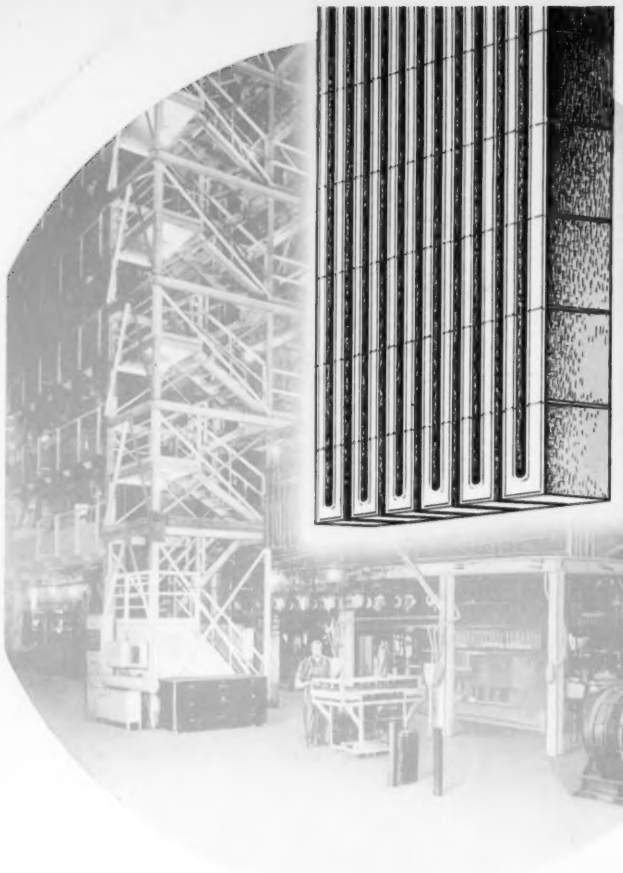

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This installation of PSC alloy duct for continuous annealing of strip steel is another example of how PSC "thin wall" construction is helping solve present-day engineering problems. Installed in the Indiana Harbor plant of Inland Steel Company, the system represents advanced designing in heat treating methods.

PSC "thin wall" construction effects hitherto impossible compactness and removability. It also introduces large economies in many types of construction, due to the savings in metal and to the lower fabricating and installation costs. Specializing in the precision fabrication of the weight-saving sheet alloys, PSC furnishes coils, ducts, flumes, manifolds, muffles and tubing for every heat and corrosion-resistant requirement; also tubes for radiant furnaces, and for furnace externals such as vent stacks. In any size and alloy.

Continuous strip steel annealing system at the Inland Steel Company plant, designed and built by Inland and Selas Corp. of America. PSC annealing ducts in black at top.

Send for Heat Treating Catalog 52

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